

MAKING CARE SAFER: EXPLORING PREDICTORS AND IMPACT OF RN BURNOUT
AND ENGAGEMENT

by
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A dissertation submitted to Johns Hopkins University in conformity with the
requirements for the degree of Doctor of Philosophy

Baltimore, Maryland
June 2018

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Abstract

Background

During the last two decades of the patient safety movement, healthcare has made much progress. Yet evidence suggests that there remains a long path forward. A 2016 study ranked deaths due to medical error as the third leading cause of death in the US. As researchers seek to ways to mitigate this, they have begun to look into the complex adaptive system within which nurses provide care to patients, in attempt to understand how changes within this system impact nurse and patient outcomes.

Purpose

The purpose of this study is to examine the relationships among work system factors (autonomy, time pressure, supportive nursing management) on inpatient hospital units and their effect on nurse outcomes (burnout and engagement) and measures of patient safety and quality (falls). We drew on the Systems Engineering Initiative for Patient Safety (SEIPS) model to identify potential relationships among our variables of interest.

Methods

To address this, we propose a descriptive correlational study using secondary data analysis combining five different operational cross-sectional data sources. Data was aggregated and analyzed at the unit level, using a convenience sample of inpatient nursing units in Johns Hopkins Hospital (JHH). This sample includes a diverse set of inpatient nursing units, including medical, surgical, pediatric, oncology, and intensive care among others. We used bivariate regression of each variable of interest (autonomy, time, supportive nursing management) with burnout as the outcome variable. Significant predictors using an alpha level of .10 were included in a

multivariable analysis. The same set of analyses was conducted with engagement as the outcome variable. Statistical analysis for mediation followed Baron and Kenny's approach, using a series of regression equations. Each variable of interest (autonomy, time pressure, supportive nursing management) shown to be significantly associated with burnout was evaluated. We next tested for significant association with the outcome variables (falls). Burnout was tested for significant association with the outcome variables (falls) after controlling for variables of interest. Subsequent analysis with engagement as the mediator was conducted. We used multivariable regression to evaluate the association between process improvement activities and work systems factors. All CUSP variables were included in the regression equation simultaneously as explanatory variables. Separate regression analysis was conducted with autonomy, time pressure and supportive nursing management as the outcome variable. The same set of analyses were conducted with burnout and engagement as the outcome variables to evaluate the association between CUSP implementation and employee outcomes.

Results

In adjusted multivariable analysis, time pressure was significantly associated with burnout ($\beta=-5.44$; 95% CI -7.02, -3.87). Supportive nursing management was significantly associated with engagement ($\beta=0.19$; 95% CI 0.07, 0.3). We didn't find evidence that burnout or engagement mediated the relationship between work system factors and patient falls. We found a significant association between CUSP implementation and nurse engagement ($p=0.05$) and a moderate effect size ($R^2=0.55$).

Conclusion

This study illustrated several important relationships among work system factors, nurse outcomes and quality improvement activities. We observed that time pressure was associated with nurse burnout, an important finding for nurse managers and hospital administrators seeking to retain nursing staff. Additionally, we found that nursing management support and CUSP implementation were associated with nurse engagement. Hospital leaders can leverage these findings to maximize engagement of nursing staff to harness the positive outcomes that are associated with increased engagement.

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Funding

Funding for this dissertation was provided by The Jonas Nurse Leaders Scholars program.

Disclaimer: The content of this study is solely the responsibility of the author and does not necessarily represent the official views of the Jonas Foundation or other funding agencies.

Dedication

I owe an enormous debt of gratitude to my parents for nurturing my curiosity and love of learning from a very early age. To my husband, Frank, I am incredibly grateful for the unwavering support you have given me to pursue and complete this journey. You are my rock, your enduring belief in me has sustained me throughout this process. To my amazing children, Ben and Jack, I am constantly in awe of all that you do and are. I can't wait to see what the future holds for you.

Acknowledgements

This dissertation would not have been possible without the support of many people.

Merging data from multiple data sources requires the help and cooperation of the data stewards for each data set. They were all amazingly generous with their time and for that I am eternally grateful. My many requests for “just a bit more” data or clarifications on how something was collected or reported were all met with quick responses. Many thanks and much gratitude to Carol Woodward, Patty Dawson, Carla Aquino, Shu Huang, Lori Paine and Melinda Sawyer.

The advice and mentoring that I have received from Cheryl Dennison Himmelfarb throughout the doctoral program has helped me immensely. Her mentorship has been instrumental to my success in this program. I am also grateful for the support of my entire dissertation committee, each of whom has graciously provided me with direction, feedback and advice during development and analysis of this research. They include: Patricia Davidson, Hae Ra Han, Ginger Hanson, Jill Marsteller, Albert Wu and Michael Rosen.

To my fellow PhD students, it has been a joy to learn with you. I am constantly impressed by your depth of knowledge and curiosity. Being a part of this cohort of amazing nurses has pushed me to excel and exceed beyond my expectations.

To my family and friends who have supported me throughout this journey I am immensely grateful for your understanding and support. I knew it would be a challenge

to enter a doctoral program as a full-time student that was located over an hour from my home, while raising very active children. I had no idea how hard it might be to juggle my many responsibilities. I couldn't have made it through the program without the support of my community of friends and family. Thank you all.

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Note. Tables and figures are numbered sequentially throughout the dissertation.

Dissertation Organization

This dissertation contains five chapters. The first chapter provides background, theoretical underpinnings, significance, and specific aims. Chapter two (Manuscript one) is a review of the current state of the science exploring the relationship between professional burnout and engagement with safety outcomes. It is currently in press with the Journal of Patient Safety. Chapters three and four are data-based manuscripts in submission ready format. Chapter three includes results and analysis from aims one and two of the study, while Chapter four provides results and analysis from aim three. An addendum to Chapter three provides details of post-hoc analysis completed to explore alternative relationships between time pressure, burnout and falls. Chapter five summarizes findings and discusses implications for practice, policy and future research.

CHAPTER 1: INTRODUCTION

Background and Rationale

Improving patient safety has been a key focus in healthcare since the Institute of Medicine report *To Err is Human* highlighted unnecessary deaths due to preventable errors and nurses play a critical role.[1] During the past fifteen years, research has focused on systematic efforts to improve organizational level factors that contribute to errors. These efforts have been far-reaching and include reduction of hospital acquired infections[2,3], improved communication and teamwork[4], implementation of barcoding technology[5], and use of pre-procedural checklists[6], among many others. However there remains a gap, a 2016 study ranked deaths due to medical errors as the third leading cause of death in the United States.[7] This gap has led researchers to explore the impact of contextual and structural factors on burnout and engagement among providers, and how this in turn impacts patient outcomes. Given the sheer number and critical role that nurses play in healthcare, understanding relationships among these factors among nurses and impact on patient outcomes is essential.

Provider burnout has a high prevalence and negative impact on patient outcomes.[9,12,13,25,26] Burnout is a job-related emotional response to stress in the work environment characterized by emotional exhaustion, cynicism and a reduced sense of personal accomplishment.[11] Burnout rates in nurses have been estimated to be between 25-33%.[8–10] Nurse burnout has been associated with higher rates of hospital acquired infections as well as a lower self-reported quality of nursing care [12–14] and has mediated the effect of both unit characteristics (i.e. staffing levels) and nursing work life factors on safety outcomes including hospital acquired infections and

patient falls.[14,15] Falls are considered a nurse sensitive indicator because their prevention lies directly within nursing scope of practice.

Research to date has minimally explored predictors of employee engagement in nursing, and the role of employee engagement in fall prevention. In contrast to burnout, employee engagement is described as a sense of work related well-being associated with worker motivation.[16] Contextual factors associated with increased nurse engagement have been identified (support services availability and lower work complexity), but an association was not found between engagement and patient safety outcomes.[17] Beyond this, there appears to be scant research exploring employee engagement and work system factors and whether engagement is a potential mechanism associated with improved patient outcomes.

Purpose and Study Aims

To address this knowledge gap, the purpose of the proposed study is to examine the relationships among work system factors (autonomy, time pressure, supportive nursing management) on inpatient hospital units and their effect on nurse outcomes (burnout and engagement) and measures of patient safety (falls). This study draws on the framework of the System Engineering Initiative for Patient Safety (SEIPS) model which suggests that the interrelationships between work systems factors affect both employee and patient outcomes.[18] The SEIPS model also suggests that engagement in process improvement activities may affect both work system factors and employee outcomes.[18]

The purpose of this study is to examine the relationships among work system factors (autonomy, time pressure, nursing management) on inpatient hospital units and

their effect on nurse outcomes (burnout and engagement) and measures of patient safety and quality (falls). To address this, we propose a descriptive correlational study using secondary data analysis combining several cross-sectional data sources.

Specific Aims and Hypotheses

Specific aims of this study are:

1. To determine which work system factors (autonomy, time pressure, nursing management support) are associated with burnout and engagement on inpatient nursing units.

Hypothesis 1.1: Low levels of work system factors will be associated with high levels of employee burnout and low levels of employee engagement after adjusting for covariates.

2. To assess the extent to which employee outcomes (burnout and engagement) mediate the relationship between work system factors and patient safety outcomes (falls).

Hypothesis 2.1: Units with lower levels of work system factors will have higher levels of burnout associated with poorer patient outcomes.

Hypothesis 2.2: Units with lower levels of work system factors will have lower levels of engagement associated with poorer patient outcomes.

3. To assess the extent to which process improvement activities are associated with work system factors, burnout and, nurse engagement on inpatient nursing units.

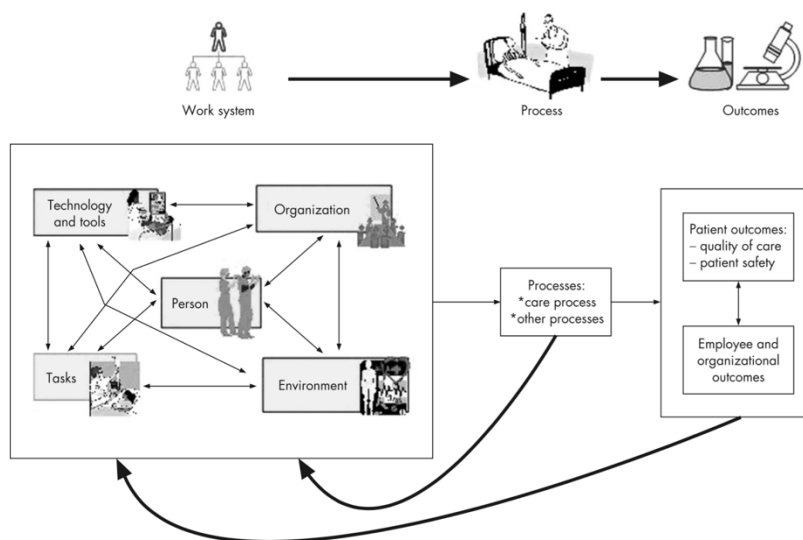
Hypothesis 3.1: Among units with higher levels of process improvement activities, there will be increased levels of work system factors.

Hypothesis 3.2: Among units with higher levels of process improvement activities, there will be lower levels of burnout and increased levels of engagement.

Conceptual/Theoretical Framework

This study is conceptually and methodologically embedded in human factors engineering, focusing on how the persons involved in patient care perform tasks within the context of organizational factors. To this effect, we draw on the SEIPS model to guide specific aims, hypothesis and key variables.

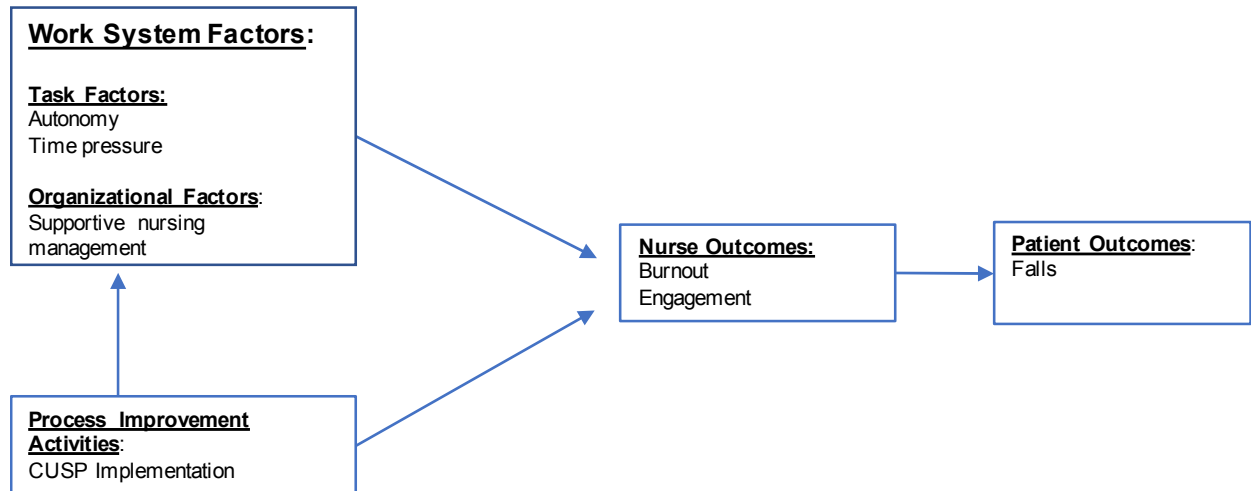
Figure 1. SEIPS model



The SEIPS model adapts Donabedian's model for assessing quality of care based on structures, processes and outcomes using a human factors engineering and safety perspective. The SEIPS model identifies inter-related work system factors that impact the process of care, and ultimately employee, organizational, and patient outcomes (Figure 1: SEIPS Model).[18] The strengths of this model include a focus on systems design and thinking which can help to ensure that important systems elements affecting patient safety are included in patient safety research. The SEIPS model follows an intuitive approach by suggesting that changes to any aspect of the work system impact the process of caring for the patient and ultimately the

outcomes of care. Based on this model, and current research, this study will include work system factors consisting of nursing autonomy, time pressure, and nursing management support (Figure 2).

Figure 2. Proposed research relationships



A sizeable body of literature has explored aspects of leadership in nursing. Nursing management support has been found to be associated with lower levels of burnout.[48,49] A 2010 systematic review suggested that leadership styles focused on relationships or people lead to better outcomes than transactional styles focused on task completion, although none of the studies included explicitly focused on quality or safety outcomes.[50] A more recent systematic review focused specifically on nursing leadership and patient outcomes found support for the conclusion that relation-based leadership styles lead to decreased mortality and improved patient safety outcomes, specifically adverse events and complications.[51]

Task work system factors included as variables in this research are autonomy and time pressure. Nursing is frequently characterized as a profession with high work demands and low control, potentially leading to increased occupational stress.[52] High work demands include increased workload pressures and competing demands on nurse time. Low control includes limited decision making latitude, limited control over work and at times an inability to adjust work

to fit patient needs, and would be reflected in a work environment characterized by low levels of autonomy. There is some evidence that the association between high job demands and low control has a negative effect on patient safety.[53] Burnout has been found to have a negative impact on nurse-rated quality of care after adjusting for other variables such as the nursing work environment.[13] Better work environments are associated with both nurse and patient reports of higher quality of care.[54]

Significance

Patient safety is a significant public health problem and a 2016 study estimated that more than 250,000 deaths occur annually due to errors.[7] It is estimated that clinical errors cost 17.1 billion dollars to the health system in 2008 alone[20], and every year hundreds of thousands of patients fall in hospitals with the average cost of a fall with injury being about \$14,000.[21] Systematic efforts to improve organizational level factors that contribute to errors has been the focus of the patient safety movement over the last fifteen years. These efforts have been far-reaching and include reduction of hospital acquired infections, improvement of communication between team members, implementation of barcoding technology for use with medication and blood administration, and the implementation of pre-procedural checklists among many others.[2,3,22–26] This approach has proven successful on a number of fronts, for example decreasing the number of patients impacted by healthcare acquired infections by 1.3 million between 2011-2013.[27] But given that there remains a substantial opportunity for making care safer, researchers have begun to explore other opportunities for improvement. Building an understanding of the impact of human performance and working conditions on patient safety, particularly among nurses who comprise the largest segment of the health workforce, is an area that has potential for

large patient safety impact as it represents an important first step to developing and implementing interventions to successfully improve patient safety in hospitals.

One factor that has a potential impact on human performance is the level of burnout or engagement. Burnout is described as a job related emotional response to stress in the work environment characterized by emotional exhaustion, depersonalization and a reduced sense of personal accomplishment which is commonly experienced by those whose work involves service to other people.[28] Healthcare workers, including nurses, fit within this category. Burnout has a significant impact on providers, organizations and patients. Prevalence estimates of symptoms of burnout in nurses range from 25-33%.[8–10] Consequences of burnout on providers can be significant including headaches, sleep disturbances, fatigue, marital problems, hypertension, anxiety, alcoholism, and myocardial infarction.[29–32] There are also potential economic consequences related to burnout. Workers experiencing burnout are more likely to leave a work environment, seek early retirement, or leave the professional entirely. In the face of growing healthcare provider shortages, a loss of qualified professionals due to burnout could have profound implications for the provision of care. Finally, burnout may have a direct impact on the patient experience of care. Providers experiencing burnout are likely to experience higher rates of cynicism, and a difficulty connecting with patients, leading to poor patient satisfaction.

The potential link between burnout and decreased cognitive performance in terms of perceptual and motor tests, participant ratings of memory and attention problems, is evident.[33] Research has also found that in conditions of high demand on executive control, individuals with elevated levels of emotional exhaustion had poorer

task performance in updating and monitoring working memory.[34] Furthermore, there is evidence that these cognitive effects may last for an extended period of time, Oosterholt et al found that after one and a half years during which participants had therapy, individuals with burnout still had minor decreases in cognitive performance.[35] This impact on cognitive performance provides a plausible link between increased levels of burnout and performance at work that leads to poor patient safety outcomes.

The relationship between burnout and patient outcomes has been minimally investigated, with only three studies providing conflicting results.[14,15,36] Spence-Laschinger and Leiter's study of nurses in Canada using a large random sample (n=8,597) identified that burnout partially mediated the relationship between work life factors (strong leadership, RN/MD collaboration, policy involvement, staffing adequacy and nursing model of care) and self-reported adverse events (falls, nosocomial infections, medication errors and patient complaints), although path coefficients were relatively small.[15] They reported significant correlations between each of the burnout subscales and adverse events as well ($r = -0.22, 0.30, 0.34$).[15] Similar to other studies, participants experiencing burnout were more likely to report higher error rates than observed errors rates,[37] raising the question of whether burnout negatively shaded the participant's perception of performance. In their analysis of a large survey (n=7076) of registered nurses in Pennsylvania combined with hospital infection data, Cimiotti et al found that burnout mediated the relationship between nurse staffing and hospital acquired infections.[14] In contrast to these studies, Davenport et al. failed to find significant relationships between burnout and risk adjusted morbidity and mortality.[36] Much of the research exploring burnout and patient safety in inpatient

settings has focused on physician participants and the role of burnout in clinical errors. Although there are some mixed findings, there appears to be a statistical trend toward an association of burnout and an increased likelihood of perceptions of errors.[38–44]

A second factor that has a potential impact on human performance is engagement, which is described as a sense of work related well-being associated with worker motivation.[16] Engagement is often depicted as the opposite end of the spectrum from burnout. Engaged employees are described as going above and beyond in the role, have a high commitment to the organization and a desire to stay with the organization. Theoretically, highly engaged employees in an organization with a high safety culture would be strongly committed to patient safety in their work.

There is very limited evidence exploring engagement with safety outcomes. Mark et al. failed to find evidence supporting the direct relationship between employee engagement and medication errors or patient falls.[17] Unfortunately, the Mark research team used a factor summated variable for work engagement consisting of average RN tenure on the unit, nursing expertise and commitment to care which is conceptually inconsistent with how other researchers have viewed engagement.[28] Additionally, a large study (n=2115) conducted with Resident physicians practicing in the Netherlands, provides the only information about employee engagement and self-reported errors, finding that highly engaged employees were significantly less likely to report two types of errors.[39]

While this body of literature presents an evolving picture of the relationships between burnout, engagement and patient safety outcomes, it is incomplete, focusing primarily on physicians and clinical errors. Extending this research to explore how levels

of burnout or engagement in nurses affect patient safety outcomes represents an important gap. Patient falls are a patient safety outcome that has relevance to nursing practice, and is unfortunately a relatively common occurrence in the inpatient hospital setting; falls are reported at a rate of 1.3-11.5 falls per 1000 patient days.[46,47] Prevention of falls is within the primary domain of nursing practice. Research is needed to better understand the relationship between nurse burnout or engagement and these patient outcomes. There is scant research exploring the impact of nurse burnout or engagement on patient falls.

We seek to extend this body of research to include a focus on patient safety, as well as explore these relationships at the unit level. As safety research shifted from an individual provider focus to a system focus, so too must research investigating burnout and engagement. As we seek to better understand the complex relationships between burnout, engagement and patient safety, evidence is emerging that organizational level interventions may be more successful in decreasing burnout than those targeted at individual providers; a recent meta-analysis identified that reductions in physician burnout from organizational interventions were more substantial compared to individual-targeted interventions.[19] Deeper understanding of unit level relationships will ultimately better equip researchers to develop organizational interventions that will reach a wider range of providers and ultimately have a stronger impact on improved patient safety.

Innovation

This study is innovative through merging multiple existing operational hospital datasets to address the research question. By merging these multiple data sets into a

single data set, the researches will be able to develop a rich source of information that can be used to address the specific aims of this research. Evaluating these data at a unit-level is an important precursor to developing unit-based or organizational level interventions. Emerging research has shown that interventions targeted at the organizational level have a greater effect on decreasing provider burnout than those at the individual provider level.[19] With an increased understanding of the nature and extent of unit level relationships, a foundation can be built to identify potential targets for interventions to improve employee outcomes and ultimately patient safety.

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CHAPTER 2: MANUSCRIPT ONE

The association between professional burnout and engagement with patient safety culture and outcomes: a systematic review

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Journal: The Journal of Patient Safety

Date of Submission: *In press* May 2018

Abstract

Objectives: In the last 20 years there have been numerous successful efforts to improve patient safety, although recent research still shows a significant gap.

Researchers have begun exploring the impact of individual level factors on patient safety culture and safety outcomes. This review examines the state of the science exploring the impact of professional burnout and engagement on patient safety culture and safety outcomes.

Methods: A systematic search was conducted in CINAHL, Pubmed and Embase. Studies included reported on the relationships among burnout or engagement and safety culture or safety outcomes.

Results: Twenty-two studies met inclusion criteria. Ten studies showed a relationship between both safety culture and clinical errors with burnout. Two of three studies reported an association between burnout and patient outcomes. Fewer studies focused on engagement. Most studies exploring engagement and safety culture found a moderately strong positive association. The limited evidence on the relationship between engagement and errors depicts inconsistent findings. Only one study explored engagement and patient outcomes, which failed to find a relationship.

Conclusions: The burnout/safety literature should be expanded to a multi-disciplinary focus. Mixed results of the relationship between burnout and errors could be due to a disparate relationship with perceived versus observed errors. The engagement/safety literature is immature, although high engagement appears to be associated with high safety culture. Extending this science into safety outcomes would be meaningful, especially in light of the recent focus on an abundance based approach to safety.

Introduction

Since the 1999 Institute of Medicine (IOM) report *To Err is Human* highlighted that between 44,000-98,000 patients died annually due to errors, patient safety has become a key focus for improvement efforts in healthcare.(1) Despite extensive attention to this issue, there has only been incremental progress in making hospitals safer. Errors still occur at an unacceptably high level; though debated, one estimate ranked deaths due to medical errors as the third leading cause of death in the United States.(2,3)

Numerous efforts to improve organizational and team level factors that contribute to errors using a systems approach and including a focus on patient safety culture have been successful. Safety culture is frequently described as an organizations' shared perceptions, beliefs, values, attitudes and competencies that combine to create a commitment to safety and an effort to minimize harm.(4) This high-level approach to decreasing error in healthcare has included a number of broad organizational processes such as medication management,(5,6) transitions and handoffs,(7) teamwork,(8-11) and communication(10) among others. Significant work has also been done to address clinical care directly, most notably in the prevention of healthcare-associated infections.(12,13) This strategy has proven successful decreasing the number of patients impacted by healthcare acquired infections by 1.3 million between 2011-2013. (14) Despite this work, a recent systematic review found that the evidence is still lacking to support many interventions to decrease adverse events (AEs) in hospitals including adverse drug events, infections, delirium, falls and surgical AEs. (15) To supplement these efforts and address the remaining substantial gaps in patient safety,

researchers have begun to expand their focus beyond organizational and team level factors. In 2015, the National Patient Safety Foundation organized an expert panel to review the state of healthcare safety in the United States and create a plan for the next fifteen years. The first recommendation from this group was for leaders to create and sustain a culture of safety within healthcare. (14)

It is possible that individual level factors could help to explain variation in safety culture within organizations. Two emerging factors being explored in safety culture research are professional burnout and engagement. The Job Demands-Resources model provides theoretical support for the potential impact of these two variables on organizational outcomes.(16) In this model, increased job demands lead to increased worker burnout, while increased job resources lead to increased levels of engagement. Burnout is a job related emotional response to stress in the work environment characterized by emotional exhaustion, depersonalization and a reduced sense of personal accomplishment. (17) Contrasting that is engagement, which is described as a sense of work related well-being associated with worker motivation. (18) In the setting of burnout, employees are likely to alter performance to conserve energy through strategic adjustments (for example less monitoring time, decreased checking for effectiveness) and in response to fatigue after-effects (risky choices).(19) On their own these strategies may not have a large impact, but in the aggregate over time their use may lead to changes in the safety culture on the unit. Patient safety culture is based on group norms. Witnessing a co-worker taking risks, avoiding double-checks or other strategic adjustments to conserve energy may change group perceptions of safety culture. Conversely seeing co-workers who are engaged and taking the time to perform

necessary safety behaviors will likely lead to perceptions of higher safety culture. However, these relationships have not been established in the literature. The purpose of this review is to explore the current state of the science investigating the impact of professional burnout and engagement on patient safety culture and safety outcomes in the inpatient hospital setting.

Methods

A systematic search was completed in CINAHL, Pubmed, and Embase with the assistance of a research librarian (Figures 1 depicts the search strategy). Search terms included “safety culture OR safety climate” AND “engagement OR burnout” AND “hospital” within the title or abstract. The search was subsequently expanded to include the term “error” to better capture safety outcomes. Search results were limited to English language research articles published from January 2005 through December 2016. A hand search was also completed by reviewing reference lists of retained articles.

The lead author screened titles and abstracts of all results based on pre-determined eligibility criteria. Eligible studies were those reporting on the relationship between at least one employee variable (burnout or engagement) and a measure of safety culture, safety climate, safety outcome, or error. Studies that explored only one variable of interest (e.g. burnout, engagement or safety culture) were excluded from analysis. Only studies that included healthcare workers in a hospital setting were included. Studies that involved healthcare workers in nursing homes, primary care, or other non-hospital settings were excluded from review. Studies appearing to meet eligibility criteria were then screened via full text review. Data was extracted by the lead

author from each study using a table designed for this review. To ensure accuracy of data extraction, the second author reviewed the table of extracted data for clarity and accuracy. This review followed PRISMA guidelines when applicable given the descriptive nature of the research reviewed.(20) As this was a systematic review and did not involve human subjects, IRB approval was not sought.

Results

Twenty-two articles were included in the review. Findings are conceptually organized with a sequential summary of burnout research followed by engagement research (Tables 1 and 2). Only one study was identified that included both burnout and engagement, which is discussed in both sections. Reported associations of each individual level factor with patient safety culture, clinical errors and patient outcomes are summarized.

Burnout and Safety Culture

The association between burnout and safety culture appears to be relatively unexplored as only two studies examined this topic. Both reported a negative association between burnout and measures of patient safety culture ($r = -0.18$ to -0.64) (Table 1).(21,22) Profit and colleagues measured safety culture using the Safety Attitudes Questionnaire (SAQ) which includes six separate domain scores, while Halbesleben and colleagues used the Agency for Healthcare Research and Quality Patient Safety Culture measure, which includes a one item safety grade and a four item safety perceptions scale. The only safety culture domain that did not have a significant relationship with safety culture was stress recognition from the SAQ.(21)

Burnout and Errors

Research focusing on the impact of burnout on clinical errors has produced mixed findings, although there appears to be an association between physician burnout and an increased likelihood of perceived errors. Eight studies, all with physicians, reported finding a significant association between burnout and self-reported errors.(23-29) Two of these studies had large random samples (n=7905, 2115), although their response rates were low (32%, 41%) raising the potential for nonresponse bias.(24, 25) A unique prospective design by West et al. showed the interdependent nature of the relationship between burnout and errors in residents, with burnout leading to errors and errors further increasing burnout.(25) The restriction to physician only participants in all of these studies limits their applicability to other professional groups.

Two studies including a wider range of disciplines (physicians, nurses, nursing assistants and physiotherapists) and one study with only nurses, reported mixed results or no association between burnout and clinical errors.(39-32) Two of these studies which used an active surveillance component to measure errors as they occurred during the study dichotomized respondents into those with and without burnout, failed to find an association between error rates and burnout.(30,31) Although Fahrhenkopf et al. did not find a significant association with active surveillance, they did find an association with self-reported errors.(30) The recent (2015) large study (n=1532, 31 ICUs) by Garrouste-Orgeas et al. in France failed to find a relationship between burnout and safety culture (measured by the SAQ) or errors, although this should be considered in light of their use of the SAQ as an aggregate score.(31) One study found no association between burnout in nurses and perceived likelihood of a medication error.(32)

Burnout and Patient Outcomes

Similar to burnout and safety culture, there is a paucity of research exploring burnout and patient outcomes; three studies providing conflicting results of the association between burnout and patient outcomes were located in this review.(33-35) Spence-Laschinger and Leiter's study of nurses in Canada using a large random sample (n=8,597) identified that burnout partially mediated the relationship between work life factors (strong leadership, RN/MD collaboration, policy involvement, staffing adequacy and nursing model of care) and self-reported adverse events (falls, nosocomial infections, medication errors and patient complaints), although path coefficients were relatively small (.02, .08 and -.27).(33) They reported significant correlations between each of the burnout subscales and adverse events as well ($r = -0.22, 0.30, 0.34$).(33) The use of self-reported adverse events over the previous year as an outcome measure has some potential for recall bias.

Using linear regression models with secondary data from a large survey (n=7076) of registered nurses in Pennsylvania combined with hospital infection data, Cimiotti et al found that burnout could be a mediating variable for the relationship between nurse staffing and hospital acquired infections.(35) In contrast, Davenport et al. failed to find significant relationships between burnout and patient outcomes.(34) Given the limited number of studies and the divergence of findings, it is too soon to draw conclusions about the relationship between burnout and patient outcomes.

Engagement and Patient Safety Culture

Five studies were identified that explored the relationship between engagement and safety culture.(36-40) Employee engagement has been shown to have a mixed

association with a variety of safety culture domains, although reported ranges were wide ($r = -0.14$ to 0.70) (Table 2).(36, 37, 39) A large ($n=10,702$, response rate 46%) descriptive study of engagement in nurses identified a number of factors associated with engagement, and identified high levels of engagement corresponded with high levels of patient safety culture and quality.(40) New measures of all variables were developed as part of this study, making it challenging to compare to other research.

Although only conducted in one health system, Daugherty Biddison used a multidisciplinary, multi-unit sample ($n=58-61$) in their retrospective, multi-time point design, providing strong support for their reported correlation ($r= 0.43-0.70$) between engagement and various domains of the Safety Attitudes Questionnaire (SAQ).(36) Collier and Fitzpatrick's finding of a strong relationship between employee engagement and safety culture is somewhat less transferable across settings as it was limited to RN's working in ICU's, had a somewhat smaller sample size ($n=26$) and did not report a response rate.(39) The negative correlation reported by Rathert, Ishqaidaf and May must be cautiously viewed in light of reported low reliability of both adapted measures ($\alpha= 0.57, 0.63$). Additionally, they reported an initial low response rate (42%) and then reported excluding a number of respondents ($n=54$) who did not provide direct patient care, raising questions about their sampling method.(37) The three studies used different measurement instruments for safety culture, making comparisons difficult, but the trend in correlation seems to be moderately strong across domains.

Two studies showed that levels of employee engagement could be used to predict patient safety culture scores.(38, 39) Collier and Fitzpatrick found that 52% of variation in ICU safety culture was predicted by employee engagement and employee

longevity on the unit, although their sample was primarily RNs.(39) Regression coefficients quantifying the magnitude of the relationship were not provided. Thorp et al. reported that both baseline employee engagement and change in employee engagement were predictive of a higher patient safety score.(38)

Engagement and Errors

A large study (n=2115) conducted with Resident physicians practicing in the Netherlands, provides the only information obtained in this review about employee engagement and self-reported errors.(25) Prins et al. report a small negative correlation ($r = -0.07$ and -0.23) between employee engagement and two types of self-reported errors, highly engaged employees were significantly less likely to report errors of either type.(25) While the sampling methodology was strong, all Residents in the Netherlands were invited to participate providing a large random sample, the generalizability is limited due to the narrow focus within a single profession. This study reported a relatively low response rate (41%) raising the risk of nonresponse bias.

Engagement and Patient or Staff Safety Outcomes

Three studies involved research with engagement and patient or staff outcomes, although two involved some overlap of data.(38, 41, 42) Workplace safety variables were included in two studies, but the researchers explored different types of relationships between the variables.(38, 42) Thorp et al. examined the effect of workplace safety on safety culture, while Mark et al. analyzed if safety culture moderated the relationship between staffing adequacy, work engagement and work conditions on workplace safety.(38, 42) Thorp et al. found that workers' compensation claims from the previous year, employee engagement scores from two years prior and

the amount of change in employee engagement score significantly predicted patient safety culture.(38) Using structural equation modeling to test their proposed model, Mark et al. also found that work engagement positively predicted safety climate, and that levels of safety climate moderated the relationship between employee engagement and needle stick injuries, but only explained a small amount of variation.(42)

Incorporating patient outcomes into the data used in their earlier research, Mark et al. failed to find evidence supporting the direct relationship between employee engagement and medication errors or patient falls.(41) In both studies, the Mark research team used a factor summated variable for work engagement consisting of average RN tenure on the unit, nursing expertise and commitment to care, which is conceptually inconsistent with how other researchers have studied engagement.(41,42)

Discussion

These studies present an incomplete picture of the relationships between burnout, engagement and safety outcomes. While the burnout literature is more extensive, its focus on physicians restricts its utility. The research exploring burnout and safety should be expanded to include a diverse set of health professional categories. As it currently stands, the majority of burnout/safety outcomes research has focused on physicians and clinical errors. As researchers begin to conceptualize burnout as a group level phenomenon it remains to be seen if the relationships found in physician groups that seem to have some support currently (e.g. correlation to safety culture, self-reported errors) will be consistent in other disciplines, or if provider role changes the relationship.

Some of the mixed evidence for relationships between burnout and clinical errors or patient outcomes could be related to several factors. It is possible that unrecognized confounding variables are present. Some studies have attempted to address this to a degree by controlling for health professionals' depression, although this did not change the likelihood of finding an association between errors and burnout.(23, 24, 28, 29-31) Another factor that may be involved is the use of self-reported measures. The relationship between burnout and self-reported errors may reflect the clinician's perception of an increase in errors, rather than reflecting an increase in actual error rates. Alternatively, it could be that another variable (hope has been reported to have this effect) may modify the relationship between burnout and self-reported measures.(28) Additionally, there may be other employee level variables that play a role in patient safety culture and outcomes such as turnover or retention.

Conceptual clarity and operationalization of concepts presents some obstacles for synthesis of this body of work. Conceptual clarity is still somewhat vague for engagement as evidenced by Mark et al.'s definition of the variable as nurse tenure, commitment and expertise.(41, 42) Operationalization of burnout, engagement and safety outcomes through a variety of measures makes it difficult to make direct comparisons of results. There are multiple instruments in use to measure safety culture, with some distinct differences between them. A review by Jackson, Sarac and Flin offers a more in-depth analysis of this topic.(43) Even when researchers use the same instruments, adaptations (scale reductions and changes to response formats) and inconsistency (use of full measurement, subscales, or summated scores) increase the complexity of interpreting relationships across studies.

The creation of burnout categories based on an aggregated MBI score is somewhat controversial, with some researchers suggesting that scores are best evaluated as a continuous variable.(44) It's possible that categorical analysis of burnout could provide a less accurate representation of the effects of burnout, a practice used by some of the research in this review. Even when researchers do categorize burnout, use of different methods limits comparisons. Although categorizing or dichotomizing burnout may facilitate analysis, it may be wise for researchers to avoid this temptation as it may mask some of the subtler nature of the relationships. The Maslach Burnout Inventory Manual strongly recommends avoiding categorization of burnout in analysis and suggests that burnout should not be considered as either present or absent.(45)

There is still much to be learned about individual factors that affect safety outcomes. More research addressing these relationships could help to better understand the direction and nature of the relationships. Moving forward there are several avenues that researchers should pursue. Theoretical models addressing the relationships among these concepts are rare because the science is still relatively immature. Development and testing of theoretical models to better describe the nature of the relationships involved seems to be a natural next step for some of this research, although there is still much that is unknown about potential confounding, mediating and moderating variables that should be included before models can be developed. As the science progresses, a stronger theoretical picture should emerge providing more clarity around the dynamics and strength of the relationships between the concepts. Research pointing to the possibility of an interdependent relationship among burnout and safety culture is intriguing, but this remains to be further developed and tested.(23)

Historically, the focus in this body of literature has been a deficit based approach, measuring burnout, as opposed to engagement. Contemporary trends are shifting towards an abundance based approach, as we see advocates encouraging organizations to adopt the concept of clinician joy at work.(46) As organizations attempt to embrace these practices, it will be incumbent upon researchers to validate the association of these concepts with patient safety culture and safety outcomes. One method forward is to use engagement data as part of the measurement for joy at work. Engagement is often measured and readily accessible in many hospitals. As is shown in this review, the opportunity exists for researchers to focus on this employee outcome in healthcare as it is currently relatively under-explored.

Limitations of this review include the possibility that the search strategy was not sufficiently broad to capture all the research characterizing the relationships of these concepts. A ten-year limitation may have been too narrow. Another term to limit the search other than hospital may have been more appropriate. As evidenced by the initial search strategy, safety culture and safety climate may be too narrow to adequately capture all the research that truly addresses this broad concept, hence the expansion to include articles that addressed errors as well.

Conclusion

Gains from the last decade of safety research should encourage researchers and clinicians about potential for success moving forward. Patient safety research has gained momentum allowing us to continue to leverage results into methods to make healthcare a safer place for patients. Exploration of individual level factors that impact patient safety culture will only strengthen our ability to make care safer in the future.

Figure 3. Search Strategy

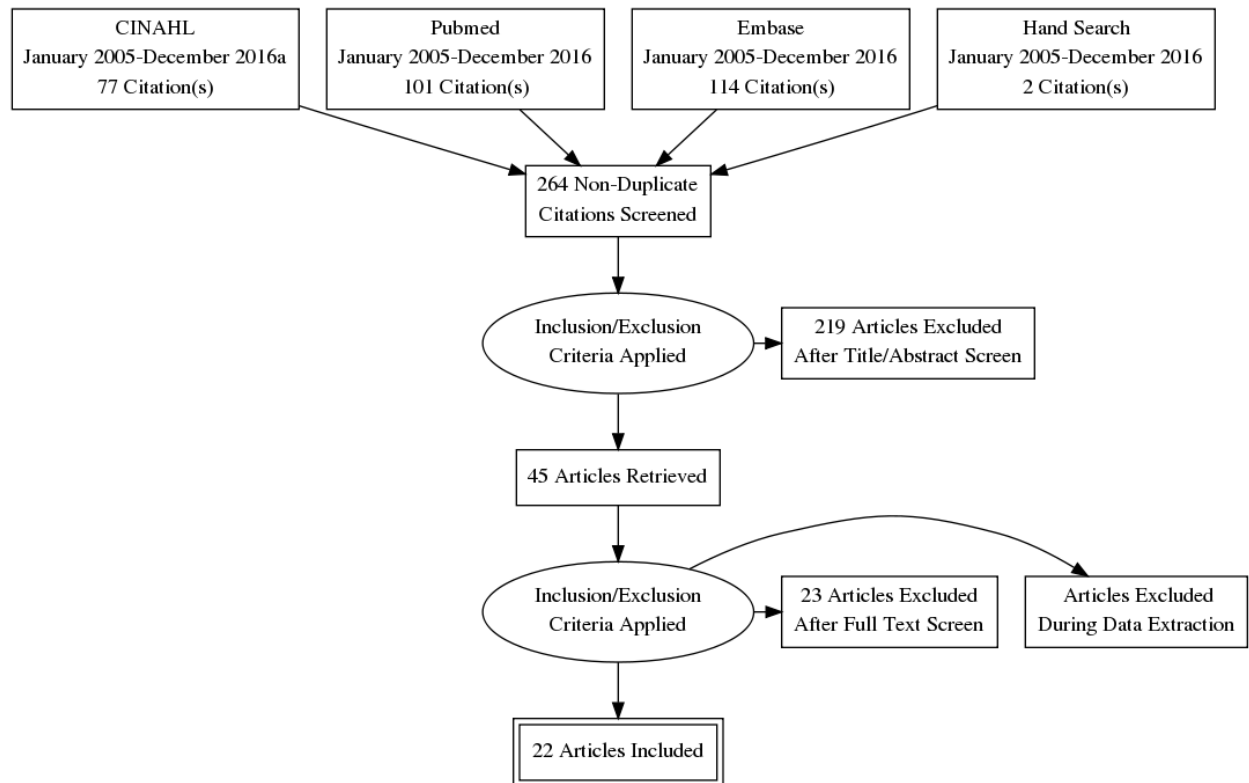


Table 1. Burnout and Safety Outcomes

Author Year Study Design	Practice setting Disciplines Included Sample size (response rate)	Variables, measures and reported reliability in study		Findings (95% CI where reported)
Garrouste-Orgeas 2015 Prospective, observational study	France, 31 ICUs ICU staff members (MDs, Nurses, nursing assistants, physiotherapists) 1534 (77%)	Burnout	MBI 22-item Fontaine French version. (Definition 1: high EE and DP, low PA Definition 2: Global MBI score)	Burnout and safety culture were not correlated (correlation coefficient -0.28) Association with medical errors: Burnout RR 0.71 (0.45,1.12) (combination of high EE, DP, & low PA)
		Depression	CES-D, 20 item scale French version (Depression in men >17, in women >23)	Global burnout score RR 0.70 (0.37, 1.33)
		Safety Culture	SAQ-ICU 63 items (Defined effective safety culture as SAQ-ICU >74)	Depression RR 2.07 (1.27, 3.38)
		Medical errors	Failure of a planned action to be completed as intended or use a wrong plan. Collected via chart review	Association with adverse events: Burnout RR 1.54 (0.96, 1.48) (combination of high EE, DP, & low PA)
		Adverse events	Patient harms caused by medical interventions. Collected via chart review	Global burnout score RR 1.01 (0.59, 1.74)
Profit et al 2014 Cross-sectional survey	US, 44 NICU's MD, Neonatal NP, RN, Respiratory Therapist, Other NICU staff 2073 (62.9%)	Burnout	MBI abbreviated 4 item EE Scale adapted response scale and scoring $\alpha = 0.85$	Correlations for burnout and safety culture domains: Teamwork -0.48 p < .01 Safety -0.38 p < .05 Job Satisfaction -0.64 p < .001 Stress Recognition 0.12 p > .05 Perceptions of Management -0.50 p < .001 Working Conditions -0.45 p < .01
		Safety Culture	SAQ 30 items	Correlations for resilience and safety culture domains: Teamwork 0.60 p < .001 Safety 0.51 p < .001 Job Satisfaction 0.65 p < .001 Stress Recognition -0.19 p > .05 Perceptions of 0.61 p < .001
		Resilience	MBI: Avg EE <25	

				Management Working Conditions 0.53 p < .001
Block et al 2013 Cross-sectional survey	US, 3 Hospitals in Baltimore Residents 55 (72%)	Burnout Safety attitudes Self-reported errors Fatigue Handover safety ACGME competencies	MBI 6 item derived version Items from SAQ teamwork, safety and collaboration domains Self-report questionnaire Epworth Sleepiness Scale Single item Perceived competence in practice-based learning, interpersonal and communication skills and systems-based practice	Correlation between burnout and self-reported errors: Make errors due to fatigue p = ns Make errors due to workload p < .05 Forget to order med p = ns Forget to convey info p < .05 Correlation between burnout and safety: I would feel safe treated here as a patient p < .001 Patients are safe this service p < .001 Correlation between burnout and quality: Quality of personal life p < .001 Quality of work life p < .001 Quality of patient care p < .001 Quality of education p < .01
De Oliveira Jr. et al 2013 Cross-sectional survey	US, all Residents from the ASA directory Residents (Anesthesia) 1508 (54%)	Burnout Depression Self-reported errors Adherence to best practices	MBI (shortened), 5 items EE, 3 items DP, 4 items PA (Burnout defined as moderate or high burnout subscale scores in >2 subscales) Harvard national Depression Screening Day Scale Self-report questionnaire Self-report questionnaire	Correlation between burnout and self-reported errors: EE 0.39 (0.32, 0.45) DP 0.45 (0.39, 0.51) PA -0.43 (-0.49, -0.35) Correlation between burnout and compliance with best practice standards: EE -0.30 (-0.37, -0.22) DP -0.43 (-0.49, -0.37) PA 0.47 (0.40, 0.53)
Cimiotti et al. 2012 Secondary data analysis, cross-	US, 161 Hospitals in PA Nurses 7076 (41%)	Burnout Nurse staffing	MBI: EE Scale Number of patients per nurse	Burnout mediated nurse staffing and hospital acquired infections. Beta coefficients: Burnout (UTI) 0.82 p = .03 Burnout (SSI) 1.56 p < .01

sectional correlation survey		Healthcare Associated Infections	Urinary tract infections & Surgical site infections			
Hayashino et al. 2012 Prospective cohort study	Japan, Physicians listed in a web-based survey company database Physicians 836 (70%)	Burnout	MBI, 17 items adapted for use with Japanese healthcare professionals	Hope modified the association btw burnout and self-perceived medical errors.		
		Depression	WHO-5, 5 items		Low Hope	High Hope
		Self-reported errors	Self-report question		RR	RR
		Hope	Hearth Hope Index, 12 items	Low EE	1.00	1.00 (0.90, 1.10)
				Mod EE	1.67 (1.03, 2.70)	1.13 (0.76, 1.67)
				High EE	3.58 (2.28, 5.60)	0.63 (0.32, 1.24)
				Low DP	1.00	1.00
				Mod DP	2.17 (1.33, 3.53)	0.85 (0.54, 1.34)
				High DP	4.63 (2.93, 7.31)	1.22 (0.73, 2.05)
				Low PA	1.00	1.00
		Mod PA	0.75 (0.06, 1.00)	0.58 (0.35, 0.94)		
		High PA	0.68 (0.45, 1.03)	0.71 (0.45, 1.13)		
Holden et al 2011 Cross-sectional survey	US, 2 Hospitals, 6 units (PICU, heme-onc-transplant, Med/Surg) in the US Nurses 176 (57%)	Burnout	EE subscale, $\alpha = 0.86$	Association with perceived likelihood of an error:		
		Likelihood of medication errors	Perceived likelihood of med error, 1 item	EE	OR 0.80 (0.52, 1.22) $p>.05$	
		Unit level workload	Staffing/resource adequacy scale, 4 items $\alpha = 0.86$	Association with burnout:		
		Job level workload (general)	Job demands scale, 3 items, $\alpha = 0.66$	Unit level (staffing)	0.45 (0.24, 0.66) $p<.05$	
		Job level workload (specific)	Monitoring demands and production responsibility subscales, 8 items, $\alpha = 0.82$	Job level (general)	0.18 (-0.13, 0.48) $p>.05$	
			Med admin concentration and effort, 2 items, $\alpha = 0.70$	Job level (specific)	0.16 (-0.04, 0.36) $p>.05$	
		Task level workload (internal)		Task level (internal)	0.07 (-0.14, 0.29) $p>.05$	
		Task level (external)	0.25 (0.07, 0.44) $p<.05$			

		Task level workload (external) Job dissatisfaction	Med admin interruptions, divided attention and rushing, 3 items, $\alpha = 0.67$ Job satisfaction/dissatisfaction scale, 3 items, $\alpha = 0.83$	
Shanafelt et al 2010 Cross-sectional survey	US, all ACS members invited to participate Surgeons (various specialties) 7905 (32%)	Burnout Depression Perceived medical errors Mental and physical QOL	MBI, 22 items, burnout defined as high score on either DP and/or EE PRIME MD, 2 items Self-report question Medical Outcomes Study Short Form	Association with perceived medical errors: EE OR 1.05 (1.04, 1.06) $p < .0001$ DP OR 1.11 (1.10, 1.12) $p < .0001$ PA OR 0.97 (0.96, 0.98) $p < .0001$ Mental QOL OR 0.94 (0.94, 0.95) $p < .0001$ Physical QOL OR 1.01 (1.0, 1.02) $p = 0.18$ Depression OR 3.21 (2.74, 3.76) $p < .0001$
Prins et al 2009 Cross-sectional survey	Netherlands, all residents in training invited to participate Residents 2115 (41%)	Burnout Self-reported errors Engagement	UBOS-C (Dutch version of MBI), 20 items, EE 8 items $\alpha = 0.89$, DP 5 items $\alpha = 0.73$, PA 7 items $\alpha = 0.79$ Self-report, 6 items with 2 types, Action/inexperience errors and errors due to lack of time UWES, 15 items, vigor 5 items $\alpha = 0.80$, dedication 5 items $\alpha = 0.88$, absorption 5 items $\alpha = 0.78$	Correlation with action/inexperience errors EE 0.20 $p < .001$ DP 0.29 $p < .001$ PA -0.05 $p < .001$ Moderate burnout 0.18 $p < .001$ Severe burnout 0.10 $p < .001$ Vigor 0.09 $p > .05$ Dedication -0.07 $p > .05$ Absorption -0.03 $p > .05$ Total -0.07 $p < .001$ engagement score Correlation with errors due to lack of time: EE 0.43 $p < .001$ DP 0.42 $p < .001$ PA -0.08 $p < .001$ Moderate burnout 0.36 $p < .001$ Severe burnout 0.23 $p < .001$ Vigor -0.23 $p < .001$ Dedication -0.24 $p < .001$ Absorption -0.11 $p < .001$ Total -0.22 $p < .001$ engagement score

West et al 2009 Prospective longitudinal cohort study	US, Internal medicine residents from the Mayo Clinic Residents 380 (88%)	Burnout Depression Self-reported errors QOL Fatigue Sleepiness	MBI, 22 items 2 items Single item self-report Single item linear analogue self-assessment Single item linear analogue self-assessment Epworth Sleepiness Scale, 8 items	Association with medical errors OR adjusted for fatigue OR adjusted for sleepiness EE 1.05 (1.03, 1.07) p<.001 DP 1.08 (1.04, 1.11) p<.001 PA 0.95 (0.92, 0.97) p<.001 QOL 0.89 (0.82, 0.96) p=.003 Depressio n 2.22 (1.50, 3.28) p<.001	OR adjusted for fatigue 1.07 (1.03, 1.10) p<.001 1.05 (0.98, 1.12) p=.15 0.94 (0.89, 0.99) p=.02 0.86 (0.75, 0.99) p=.03 2.13 (1.11, 4.10) p=.02
Halbesleben et al 2008 Cross-sectional survey	US, VA Hospital located in the Midwest Nurses 135 (50%)	Burnout Patient safety outcomes	MBI, EE 9 items, $\alpha = 0.94$ DP 5 items, $\alpha = 0.87$ AHRQ Patient Safety Culture Survey, Safety Grade 1 item, Safety Perceptions 4 items α =0.81, Event reports 1 item, Near-miss frequency reporting 1 item $\alpha = 0.87$	Association between burnout with safety outcomes: EE Safety grade Safety perceptions 1 Event reports Near-miss reporting frequency	DP -0.16 p<.05 -0.26 p<.05 p<.00 0.01 p=ns -0.36 p<.01
Davenport et al 2007	US, General/Vascular Surgical Services at 44 VA Hospitals & 8	Burnout Safety Culture	EE subscale 4 items $\alpha =$.82 SAQ 30 items, teamwork climate $\alpha = .78$, safety	Teamwork	Mortality -0.01 p=.96 Morbidity -0.11 p=.45

Cross-sectional descriptive correlation	Academic Medical Centers Physicians and Nurses 6,083 (52%)	Communication & Collaboration Mortality Morbidity	climate $\alpha = .77$, working conditions $\alpha = .72$, job satisfaction $\alpha = .83$, recognition of stress effects $\alpha = .71$, perceptions of management $\alpha = .54$ SAQ, 1 item Patient death in or out of the hospital from any cause within 30 days after surgery* Having 1 or more of 21 specific postop complications up to 30 days after surgery*	Safety climate -0.03 p=.83 -0.04 p=.77 Job satisfaction -0.01 p=.97 0.02 p=.87 Recognition of stress 0.08 p=.55 -0.07 p=.63 Working conditions -0.17 p=.22 -0.07 p=.60 EE 0.13 p=.36 0.02 p=.88 Correlation of communication and collaboration by discipline with risk-adjusted morbidity Attending MDs -0.38 p<.01 Resident MDs -0.25 p=.08 Nurses -0.14 p=.32 Others 0.05 p=.73
Fahrenkopf et al 2007 Prospective cohort study	US, 3 Pediatric Hospitals (Boston and Baltimore) Residents 123 (50%)	Burnout Depression Self-reported medical error Medication errors	MBI, 22 items, defined burnout as a high score on both EE and DP Harvard national depression screening tool, 10 item Survey, 2 items Chart review	Medication error rates Depressed 1.55 (0.57, 4.22) Non-depressed 0.25 (0.14, 0.46) Burnout 0.45 (0.20, 0.90) Non-burnout 0.53 (0.21, 1.33) Residents with burnout more likely to self-report errors due to sleep deprivation (p=.05) but not due to errors not due to sleep deprivation (p=.23). Self-report error rates did not differ for residents with and without depression for either errors due to sleep deprivation (p=.28) or errors not due to sleep deprivation (p=1).
Spence Laschinger & Leiter 2006	Canada Nurses 8,597 (59%) [†]	Burnout Staffing adequacy	MBI 22 items , EE $\alpha = .91$, DF = .78, PA $\alpha = .80$ NWI-PES staff and resource adequacy subscale, 4 items $\alpha = .78$	Association between burnout and adverse events: EE 0.02 p=ns DP 0.08 p<.05

Cross-sectional survey		<p>Adverse Events Self-report of frequency of falls, nosocomial infections, med errors and patient complaints $\alpha = .79$</p> <p>Nursing Model of care NWI-PES nursing foundations for quality of care subscale, 8 items $\alpha = .72$</p> <p>Strong leadership NWI-PES nurse manager ability/support of nurses subscale, 4 items $\alpha = .84$</p> <p>RN/MD Collaboration NWI-PES collegial nurse/physician relationships subscale, 3 items $\alpha = .83$</p> <p>Policy Involvement NWI-PES nurse participation in hospital affairs subscale, 9 items $\alpha = .79$</p>	<p>PA -0.27 $p < .05$</p> <p>Staffing Adequacy -0.13 $p < .05$</p> <p>Nursing Model of Care -0.25 $p < .05$</p>
West et al 2006 Prospective longitudinal cohort study	US, Internal medicine residents from the Mayo Clinic Residents 184 (84%)	<p>Burnout Depression 2 items</p> <p>Self-reported errors Single item self-report</p> <p>QOL Single item linear analogue self-assessment</p> <p>Empathy Interpersonal Reactivity Index, Cognitive domain 7 items, Emotive domain 7 items</p>	<p>Association with self-perceived major medical error in previous 3 months:</p> <p>EE 4.58 (1.71, 7.46) $p = .002$</p> <p>DP 2.45 (0.94, 3.97) $p = .002$</p> <p>PA -2.59 (-4.22, -.097) $p = .002$</p> <p>QOL -0.39 (-0.72, -0.06) $p = .02$</p> <p>Depression 3.29 (1.90, 5.64) $p = .001$</p> <p>Emotive empathy -0.56 (-1.39, 0.28) $p = .19$</p> <p>Cognitive empathy -0.72 (-1.59, 0.15) $p = .10$</p> <p>Association with self-perceived major medical errors in the 3 months following:</p> <p>EE OR 1.07 (1.03-1.12)</p> <p>DP OR 1.10 (1.04-1.16)</p> <p>PA OR 0.93 (0.88-0.99)</p> <p>QOL OR 0.93 (0.83, 1.04)</p> <p>Depression OR 1.93 (0.93, 3.99)</p>

			Emotive empathy	OR 0.91 (0.84, 0.98)
			Cognitive empathy	OR 0.91 (0.84, 0.98)

*Outcomes were adjusted for a uniformly defined set of 60 patient preoperative risk factors, surgical complexity (measured using work relative value units) and surgical service.

†Response rate is reported for the full Canadian sample from the *International Survey of Hospital Staffing and Organization of Patient Outcomes* (n=17,965). This study used a subsample of nurses from Ontario and Alberta.

MBI: Maslach Burnout Inventory

EE: Emotional Exhaustion

DP: Depersonalization

PA: Personal Accomplishment

CES-D: Center of Epidemiologic Studies Depression Scale

SAQ: Safety Attitudes Questionnaire

WHO-5: World health Organization-Five Well-Being Index

PRIME MD: Primary Care Evaluation of Mental Disorders

UBOS-C: Utrecht Burn-out Scale

UWES: Utrecht Work Engagement Scale

QOL: Quality of Life

AHRQ: Agency for Healthcare Research and Quality

Table 2. Engagement and Safety Outcomes

Author Year Study Design	Practice setting Disciplines Included Sample size (response rate)	Variables, measures and reported reliability in study		Findings
Collier 2016 Descriptive retrospective design	US, 26 ICUs in a Midwestern healthcare system Nurses No reported total sample size or response rate	Engagement Patient Safety Culture	Gallup Q ¹² Survey, 12 items AHRQ HSOPSC, 12 safety dimensions, 42 items	Association with engagement: Total patient safety score 0.65 p < .01 Feedback and communication about error 0.66 p < .001 Teamwork within hospital units 0.64 p < .001 Frequency of event reporting 0.56 p < .01 Organization learning/continuous improvement 0.47 p < .05 Teamwork across hospital units 0.46 p < .05 Communication openness 0.46 p < .05 Nonpunitive response to error 0.46 p < .05 Overall perceptions of safety 0.43 p < .05 Supervisor/manager expectations and actions to promote safety 0.38 p < .05 Hospital management support for patient safety 0.36 p > .05 Staffing 0.27 p > .05 Hospital handoffs and transitions 0.23 p > .05
Daugherty Biddison 2016	US, 58-61 inpatient units in Johns Hopkins Hospital All staff SAQ response rates:	Engagement Patient Safety Culture	Gallup Q ¹² Survey, 12 items SAQ, 4 domains	Association with engagement: Teamwork climate 0.66-0.70 Safety climate 0.65-0.70

Descriptive retrospective design	2009 2473 (90.9%) 2011 2646 (73.8%) 2013 3020 (73.2%) Q ¹² response rates: 2009 2041 (63%) 2011 2024 (64%) 2013 2383 (68%)			Perceptions of hospital management 0.43-0.45 Perceptions of unit management 0.60-0.69																									
Lowe 2012 Cross sectional survey	Canada, 16 hospitals Healthcare employees 10,702 (46%)	Engagement Patient Safety Culture Quality Patient-centered care (PCC) Retention Work environment	NRC Picker EES Engagement scale, 5 items $\alpha = .92$ NRC Picker EES PSC scale, 6 items $\alpha = .78$ NRC Picker EES, 1 item NRC Picker EES PCWE, 6 items $\alpha = .88$ NRC Picker EES, 1 item NRC Picker EES, job characteristics, training and development, work team, immediate supervisor, senior management & organization dimensions, 36 items	Outcomes by level of engagement: <table> <tr> <th></th><th>Low</th><th>Med</th><th>High</th><th>p <</th></tr> <tr> <td>PSC (high)</td><td>11%</td><td>29%</td><td>58%</td><td>.001</td></tr> <tr> <td>Quality (high)</td><td>21%</td><td>42%</td><td>68%</td><td>p < .001</td></tr> <tr> <td>PCC (high)</td><td>21%</td><td>28%</td><td>46%</td><td>p < .001</td></tr> <tr> <td>Retention</td><td>52%</td><td>80%</td><td>90%</td><td>p < .001</td></tr> </table>		Low	Med	High	p <	PSC (high)	11%	29%	58%	.001	Quality (high)	21%	42%	68%	p < .001	PCC (high)	21%	28%	46%	p < .001	Retention	52%	80%	90%	p < .001
	Low	Med	High	p <																									
PSC (high)	11%	29%	58%	.001																									
Quality (high)	21%	42%	68%	p < .001																									
PCC (high)	21%	28%	46%	p < .001																									
Retention	52%	80%	90%	p < .001																									
Thorp et al 2012 Longitudinal correlational design	US, Loma Linda University Health System Clinical employees 2007 3783 (41%) 2009 4862 (50%) Change in safety culture 2007 2911 2009 3140	Engagement Patient Safety Culture Workers compensation claims	Gallup Q ¹² Survey, 12 items aHSOPSC, 19 items Composite score ICC = 0.79 Needlestick injuries, falls & back injuries for 2007, 2008	Relationship with patient safety score: Workers comp claims (2008) -0.18 p = .005 Engagement (2007) 0.77 p < .001 Change in engagement 0.66 p < .001																									

			Relationship with change in patient safety score: Workers comp claims (2008) -0.12 p = .07 Engagement (2007) 0.49 p < .001 Change in engagement Patient safety score (2007) 0.67 p < .001 -0.86 p < .001
Prins et al 2009 Cross sectional survey	Netherlands, all residents in training invited to participate Residents 2115 (41%)	Engagement UWES, 15 items, vigor 5 items α = 0.80, dedication 5 items α = 0.88, absorption 5 items α = 0.78 Self-reported errors Self-report, 6 items with 2 types, Action/inexperience errors and errors due to lack of time Burnout UBOS-C (Dutch version of MBI), 20 items, EE 8 items α = 0.89, DP 5 items α = 0.73, PA 7 items α = 0.79	Correlation with action/inexperience errors EE 0.20 p<.001 DP 0.29 p<.001 PA -0.05 p<.001 Moderate burnout 0.18 p<.001 Severe burnout 0.10 p<.001 Vigor 0.09 p>.05 Dedication -0.07 p>.05 Absorption -0.03 p>.05 Total engagement score -0.07 p<.001 Correlation with errors due to lack of time: EE 0.43 p<.001 DP 0.42 p<.001 PA -0.08 p<.001 Moderate burnout 0.36 p<.001 Severe burnout 0.23 p<.001 Vigor -0.23 p<.001 Dedication -0.24 p<.001 Absorption -0.11 p<.001 Total engagement score -0.22 p<.001
Rathert et al 2009	US, 1 Northwestern US Hospital	Engagement	Adapted from May et al (2004), 4 items α = .57 (reported alpha Correlation with engagement: Patient safety -.14 p < .01

Cross sectional survey	Clinical care providers (medical units) 306 (42%)	Overall patient safety perceptions	for 9 item scale prior to dropping 5 items) AHRQ Quality Patient Safety Culture Survey, adapted, 4 items $\alpha = .63$	Patient focus	-.08	p = ns
				Quality improvement	-.12	p = ns
				Empowerment	-.03	p = ns
		Continuous Quality Improvement	Quality in Action, Quality Improvement subscale, 5 items $\alpha = .87$, Patient Focus subscale, 5 items $\alpha = .82$, Empowerment subscale, 6 items $\alpha = .86$	PCC	-.21	p < .01
				Ethical climate	-.02	p = ns
		PCC	Study specific, 12 items, $\alpha = .81$	Psychological safety	-.09	p = ns
		Ethical climate	Adapted from Cullen et al. (2003), 9 items $\alpha = .86$	Commitment	-.08	p = ns
		Psychological safety	Adapted from Edmondson (1996), 7 items $\alpha = .63$			
		Organizational commitment	Mowday, Steers, & Porter (1970) instrument, 7 items $\alpha = .86$			
Mark et al 2008 Longitudinal correlation survey	US, 146 acute care hospitals, medical surgical units Nurses (by data collection round) 4911 (75%) 3689 (58%) 3272 (53%)	Engagement	Factor summated variable: average RN tenure on unit & aggregated scores from Nursing expertise scale (8 items, $\alpha = .92$) and Commitment to care (8 items $\alpha = .82$)	Relationship with safety climate:		
				Unit capacity	-0.12	p = ns
				Engagement	0.44	p < .05
				Work conditions	1.71	p < .05
		Safety climate	Combined Error orientation scale and Zohar Safety Climate Scale, #	Relationship with medication errors:		
				Unit capacity	-0.31	p = ns
				Engagement	-0.24	p = ns
				Work conditions	-0.01	p = ns
				Safety climate	0.09	p = ns
				Moderation effects:		
				Unit capacity-safety	0.05	p < .05
				Engagement-safety	0.01	p = ns

		Medication errors	items not reported $\alpha = .95$ Incident report data for 6 months, scaled to 1000 inpatient days	Work conditions-safety	0.00	p = ns
		Falls	Incident report data for 6 months, scaled to 1000 inpatient days	Relationship with falls:		
				Unit capacity	0.08	p = ns
				Engagement	-0.13	p = ns
				Work conditions	0.04	p = ns
				Safety climate	-0.01	p = ns
		Unit capacity	Proportion of RN's among total unit staff & proportion of RN's with BSN	Moderation effects:		
				Unit capacity-safety	0.03	p < .05
				Engagement-safety	-0.01	p = ns
				Work conditions-safety	0.00	p = ns
		Work conditions	Aggregated score of: Control over nursing practice scale (16 items, $\alpha = .92$), Participation in decision making scale (6 items, $\alpha = .78$), Relational coordination scale (7 items, $\alpha = .95$)			
Mark et al 2007 Longitudinal correlation survey	US, 146 acute care hospitals, medical surgical units Nurses(by data collection round) 4911 (75%) 3689 (58%) 3272 (53%)	Engagement	Factor summated variable: average RN tenure on unit & aggregated scores from Nursing expertise scale (8 items, $\alpha = .92$) and Commitment to care (8 items $\alpha = .82$)	Relationship with safety climate:		
				Unit capacity	-0.16	p = ns
				Engagement	0.43	p < .05
				Work conditions	1.75	p < .05
		Safety climate	Combined Error orientation scale and Zohar Safety Climate Scale, # items not reported $\alpha = .95$	Relationship with needlesticks:		
				Unit capacity	0.03	p = ns
				Engagement	-0.02	p = ns
				Work conditions	0.01	p = ns
				Safety climate	0.00	p = ns
				Moderation effects:		
				Unit capacity-safety	0.00	p = ns
				Engagement-safety	-0.01	p < .05
				Work conditions-safety	0.01	p < .05

		Medication errors	Incident report data for 6 months, scaled to 1000 inpatient days	Relationship with back injuries: Unit capacity 0.08 p = ns Engagement -0.01 p = ns Work conditions 0.02 p = ns Safety climate -0.03 p < .05
		Falls	Incident report data for 6 months, scaled to 1000 inpatient days	Moderation effects: Unit capacity-safety -0.01 p = ns Engagement-safety -0.00 p = ns Work conditions-safety 0.01 p < .05
		Unit capacity	Proportion of RN's among total unit staff & proportion of RN's with BSN	
		Work conditions	Aggregated score of: Control over nursing practice scale (16 items, $\alpha = .92$), Participation in decision making scale (6 items, $\alpha = .78$), Relational coordination scale (7 items, $\alpha = .95$)	

AHRQ: Agency for Healthcare Research and Quality

HSOPSC: Hospital Survey on Patient Safety Culture

SAQ: Safety Attitudes Questionnaire

EES: Employee Experience Survey

aHSOPSC: abbreviated Hospital Survey on Patient Safety Culture

PCC: Patient Centered Care

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CHAPTER 2: ADDENDUM

Falls

Accidental patient falls are a relatively common occurrence in the hospital setting, with rates reported from 1.3 to 11.5 falls per 1000 hospital days.[1,2] Approximately 26% of these falls result in patient injury with the majority of injuries reported as minor (86%), followed by moderate injuries (10%), severe injuries (4%) and death (<1%).[2] Patient falls have a substantial negative impact on patients, providers and health systems. Patient falls complicate hospital stays and are associated with an increased length of stay resulting in an average of \$14,000 increase in hospital costs.[3] Hospitals are also at risk for increased costs of litigation related to accidental falls. Beyond the cost associated with falls, adult patients in academic hospitals and large metropolitan hospitals report falling and getting hurt as a larger fear during hospitalization than being misdiagnosed, having the wrong test or procedure done, or being mistaken for another patient.[4]

Causes for falls are complex, leading to difficulty in predicting and preventing them. Falls have been linked to both environmental and patient factors. Potential environmental factors linked to falls include time of day, type of unit, activity at the time of the fall, and higher number of patient days.[1,5] Some types of units are commonly associated with higher fall rates (neurology, medical) but there does appear to be some discrepancy between units with similar patient populations, pointing to the potential for environmental factors accounting for the difference rather than patient population.[1] Individual patient factors have been tied to increased fall rates including prescription of “culprit” drugs (specifically centrally acting sedative hypnotics), urinary

incontinence/frequency, agitation/confusion, recent history of falls, and lower limb weakness.[6]

In an effort to identify fall risk and prevent falls before they occur, a number of fall risk assessments have been created and studied.[6,7] One systematic review evaluating several fall prevention tools showed that their accuracy in prediction was not better than the clinical judgement of nurses.[7] This has important relevance to the proposed research as the experience of burnout has the potential to impact clinical judgement of nurses and their ability to act on those judgements, providing a theoretical link between high burnout levels in nurses and high fall rates in patients.

Comprehensive Unit-based Safety Program

The comprehensive unit-based safety program (CUSP) was originally developed and implemented in ICU's at Johns Hopkins Hospital as a tool to improve patient safety on hospital units through a systematic change management processes.[8] Since that time, CUSP implementation has evolved to a five step process including baseline culture assessment, staff training in the science of safety, identification of staff concerns, partnership with senior executives, and learning from defects.[8–11] CUSP is a local process; the team chooses process improvement activities based on staff identification of the most pressing patient safety issues on the unit. Partnership with hospital executives provides teams with the ability to address potential barriers at a higher organizational level when necessary.

CUSP has shown to be a powerful tool for implementing and sustaining improvements in patient safety. It's focus on improvement of communication and teamwork has been shown to positively improve patient safety culture.[8,10] The use of CUSP combined with

evidence-based infection control guidelines in the Keystone initiative in Michigan has shown significant and sustained reductions in central line associated blood stream infection rates in ICUs[12] and this project was replicated in Connecticut.[13] Several additional studies including a randomized control trial have replicated these results in other hospitals throughout the country.[11,14] CUSP has been shown impact workforce outcomes, reducing nurse turnover in units where it has been implemented.[8,10] More recently, CUSP has been shown to positively impact patient experience, extending its utility beyond direct patient safety outcomes and clinical care.[15] Research to date has not explored the impact of CUSP on work system factors or employee outcomes of burnout and engagement.

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CHAPTER 3: MANUSCRIPT TWO

The role of time pressure and supportive nursing management in decreasing burnout and increasing engagement in nurses: a cross sectional study

Abstract

Objective: Examine relationships among selected work system factors on inpatient hospital units and their effect on nurse burnout, engagement, and patient falls.

Background: Burnout has significant negative impacts. Identifying covariates may help develop interventions for preventing burnout. Increased levels of nurse engagement may positively impact patient and organizational outcomes. Knowledge of predictors of engagement could provide potential leverage to capitalize on this positive impact.

Methods: This cross-sectional descriptive study used linear regression to evaluate relationships among variables. Burnout and engagement were evaluated as mediators for patient falls using negative binomial models.

Results: In multivariable models, time pressure was associated with burnout, and supportive nursing management was associated with engagement. Time pressure and burnout were related to falls, but models did not indicate mediation.

Conclusions: To minimize burnout, hospitals should seek to mitigate time pressure on nurses. Administrators striving to enhance nurse engagement should focus on the role of nurse managers.

Introduction

Burnout is a job-related, emotional response to stress in the work environment characterized by emotional exhaustion (EE), cynicism and a reduced sense of personal accomplishment.[1] Nurse burnout is estimated to affect between 25 and 33% of active nurses [2–4] and negatively impacts quality of nursing care and patient outcomes. Lowering nurse burnout rates by 30% resulted in over 6,200 fewer annual hospital acquired infections.[5] EE is the most reliable and commonly measured component of burnout, as well as the first component of burnout to manifest.[6] Because of this, EE could be considered an early warning signal for developing the full syndrome of burnout.

In contrast, employee engagement is a sense of work-related well-being associated with worker motivation.[7] Outside healthcare, higher levels of employee engagement are associated with increased productivity, job performance, employee retention, employee safety, customer satisfaction and profit. Nursing researchers have found that outcomes of higher job satisfaction, compassion satisfaction, care quality, and lower intent to leave nursing are associated with increased levels of engagement[8], and nurse engagement, in turn, is promoted by support services availability and lower work complexity. No association has yet been identified between engagement and patient safety outcomes.[9–11]

Conceptually, this study relied on the System Engineering Initiative for Patient Safety (SEIPS) model, a human-factors engineering perspective on the complex adaptive system within which nurses work. This complex adaptive system creates chances for latent error and lapses in patient safety.[12] The SEIPS model identifies

inter-related work system factors that impact the process of care, and ultimately patient, organizational, and employee outcomes including engagement and EE.[13]

We chose explanatory variables based on the SEIPS model, the burnout and engagement literature, and availability of data. Six general work life areas (workload, control, rewards, community, fairness and values) shown to impact employee burnout were considered for inclusion.[14] We included the following unit-level work system factors in the study as they matched both the SEIPS model and work life areas: time pressure, autonomy and supportive nursing management. According to the model, the effect of nursing work system factors on safety outcomes (e.g. hospital acquired infections and patient falls) may be mediated by nurse burnout.

Patient falls were identified as a safety outcome because of their relatively common occurrence in the hospital setting and substantial negative impact.[15,16] Causes for falls are complex, leading to difficulty in predicting and preventing them. Falls have been linked to diverse environmental and patient factors.[15,17,18] Although several specific unit types are commonly associated with increased fall rates, discrepancies among similar units seem to indicate that other environmental factors beyond patient population may contribute to differences.[15]

Purpose

The purpose of this study was to examine the relationships on inpatient hospital units among work system factors (autonomy, time pressure, supportive nursing management) and their effect on nurse outcomes (EE and engagement) and patient falls (Figure 1). We hypothesized that 1) higher nurse satisfaction with work system factors would be associated with lower levels of burnout and higher levels of

engagement, and 2) burnout and engagement would partially mediate the relationship between work system factors and patient falls.

Methods

Study design

We used a cross-sectional observational design to analyze existing data for 64 units from an 1100-bed tertiary medical center in the Mid-Atlantic region of the United States from March to September 2015. We cleaned and merged unit-level data from five internal operational databases (Table 3). The Johns Hopkins University Institutional Review Board deemed this research exempt from review.

Variables

We obtained data for autonomy, time pressure and supportive nursing management from the National Database of Nursing Quality Indicators (NDNQI) RN Survey.[19,20] Because of its primacy in burnout, EE is commonly used as a single measure for burnout.[21] Our study measured levels of nurse burnout using a 5-item adapted version of the EE subscale of the Maslach Burnout Inventory (MBI). Responses to individual items on the scale are summed for a final score ranging from 0-30 with higher scores indicating higher levels of burnout. To determine suitability for unit-level aggregation of this MBI data, ICC (1, k) was calculated. Engagement was measured using the twelve question Gallup Q¹² survey. Convergent validity of the Q¹² has been shown with the Utrecht Work Engagement Scale.[22] Scores on each item range from 1-5 with a higher score indicating better engagement. Scores are aggregated at the unit level for each indicator, and then averaged across all indicators to provide a unit grand

mean score of the overall items. Aggregation of data at the unit level is common practice for the RN Survey items and Gallup Q¹². [19,22]

Unit aggregated patient fall rates over a three-month period (July-September 2015) were included as a measure of patient safety. A fall was defined as “a sudden, unintentional descent, with or without injury to the patient, that results in the patient coming to rest on the floor, on or against some other surface (e.g., a counter), on another person, or on an object (e.g., a trash can)”. [23]

Statistical Analysis

Missing data were identified in the MBI data set for less than 1% of individual responses. We computed scores on multi-item scales using mean replacement as long as at least 75% of items in the scale were answered. Participants were dropped from the sample if they answered less than 75% of items.

We entered all work system factors with bivariate regression *p* values of less than 0.10 on burnout and engagement into a multivariable regression controlling for the average unit level of nurse education and longevity of employment on the unit. Standardized regression coefficients were calculated to determine the relative importance of covariates.

Mediation analysis on the 44 units reporting meaningful falls data followed Baron and Kenny’s (1986) approach.[24] Each work system factor was evaluated for significant association with burnout or engagement. Next, these variables were tested for significant association with patient falls, using negative binomial regression as the outcome was an over-dispersed count variable. To assess mediation, we added burnout

to the regression on falls, controlling for each work system factor. Covariates included a dichotomous indicator for unit type based on fall risk, average unit level of nurse education and longevity of employment on the unit. Total patient days over the three-month time-frame was included as an exposure in the models to adjust for differences in patient volumes between the units. Mediation was deemed present if burnout was significantly related to patient falls *and* the previously significant relationship between the work system factor and patient falls was diminished. Analysis of engagement as a mediator was explored subsequent to burnout. Alpha for significant difference was set at 0.05.

Results

Final sample size for each analysis is indicated in the tables. The average nursing full-time equivalents (FTE) per unit was 37.94 (range 10.61-141). The average length of nurse employment per unit was 8.29 years. This hospital had a high percentage of nurses prepared at or above the bachelor's level (76%, range 57%-96%). The majority of nurses work 12 hour shifts. Overall, units had a positive outlook on all three work system factors, with unit mean scores indicating a tendency to agree that they had sufficient time, autonomy and nursing leadership. The ICC for burnout was 0.73, indicating a satisfactory level of within-group correlation to justify aggregation at the unit level. The mean burnout level was 14.51 (SD=3.09). The mean engagement level was 3.93 (SD=0.3).

Average patient days per unit was 1710 (range 752-3658) from July to September 2015. On units reporting it (n=51), average nursing hours per patient day was 13.37. The average patient fall rate for the three-month period was 3.42 falls

(SD=3.89, range 0-16). There was a large amount of variability both within and between unit types on all three outcomes (burnout, engagement and patient falls).

All three work system factors were significantly related to both burnout and engagement (Table 4). In the adjusted multivariable analysis, time pressure remained significantly associated with burnout ($\beta=-5.44$; 95% CI -7.02, -3.87), and supportive nursing management remained significantly associated with engagement ($\beta=0.19$; 95% CI 0.07, 0.3).

In unadjusted analysis, the only work system factor found to be significantly related to falls was time pressure (Incident Rate Ratio [IRR]=0.56, $p=.049$). Burnout was independently associated with falls (IRR=1.1, $p=0.024$) however engagement was not (IRR=0.55, $p=0.18$). In unadjusted analysis, the association between burnout and falls was not significant when accounting for time pressure. In adjusted analysis, there were no significant relationships between work system factors, nurse outcomes and patient falls (Table 5).

Discussion

Variables associated with burnout and engagement

We found preliminary support for our hypothesis that work system factors were associated with nurse burnout and engagement. Specifically, increased time pressure on nurses was associated with nurse burnout. This aligns with recent research indicating that increased workload is a risk factor for EE in nurses.[25] The link between time pressure and burnout in nurses is important for establishing interventions to impact distal outcomes of burnout identified in other research, including increased patient falls, hospital acquired infections, decreased quality of self-reported nursing care, and nurse

turnover intentions.[5,26–29] Central to the discussion of time pressure on nurses is staffing. The link between nurse staffing and patient outcomes is well established, although the mechanism is likely complex and multifactorial.[30–33] Staffing was not included as a variable in this research because this single institution has minimal staffing variation, essentially controlling for staffing among like-units. Nurse staffing for the majority of units in this hospital compares favorably with national benchmarks for like-units. The identification of this association between time pressure and burnout given generally favorable staffing may point towards a strong relationship between these variables.

This research underscores that individual-focused interventions cannot fully prevent burnout if influences include unit- or organization-level variables.[34] In particular, interventions such as mindfulness and resilience training that do not address time pressure cannot fully address systematic causes of burnout. Effective interventions should target multiple levels including the organization of work, and individual employees. Considering the interdependent nature of burnout and errors (or at least, perception of errors), partial solutions seem unlikely to be adequate in the long-term.[35]

Our analysis also found that higher levels of supportive nursing management were associated with higher levels of nurse engagement. This is consistent with findings from a systematic review linking leadership behaviors and practices with performance motivation for nurses.[36] A recent review of leadership practices of nurse managers found associations with patient satisfaction, mortality, medication errors, restraint use and hospital acquired infections.[37] Our findings further demonstrate the substantial impact of positive nurse management.

Variables associated with patient falls

We hypothesized that nurse outcomes mediated the relationships between work system factors and patient falls. Our proposed mediated pathways were not statistically significant. Identifying meaningful predictors of patient falls is complex because these potentially include patient, provider and organizational factors. Patient factors such as age, mental status, illness severity, use of ambulatory aids, and use of “culprit” drugs are commonly associated with patient falls.[18] Organizational factors including unit type, patient acuity, patient volume and unit layout have been associated with patient falls.[15,17] Except for unit type and patient volume, data for these variables were unavailable for inclusion in this research. When we adjusted for a dichotomous unit type indicator of fall risk, the previously significant relationships between time pressure, burnout and falls were no longer significant indicating that unit type played a role in explaining the variance of falls in our data.

Limitations

Limitations of the study include that there may be individual factors that influence burnout such as anxiety and depression. Data for these variables were unavailable for inclusion in this research but would be important to include in future longitudinal studies. The study may have been underpowered. We conducted power estimation *a priori* however were restricted in the number of data points available. Given the novelty of this analysis, we responded to sample size limitation with parsimonious specifications and were careful not to over-conclude based on these results, but instead find them

suggestive of work that needs further investigation. Because this research was carried out in a single hospital, generalizability to smaller, non-academic teaching hospitals may be limited. Subsequent research should examine these relationships in a diverse sample of hospitals.

Conclusion

This research provides empirical evidence supporting the growing argument that hospital administrators should identify and intervene in situations of increased time pressure experienced by nurses. Increased time pressure was associated with increased rates of nurse burnout. Given the negative consequences associated with each of these outcomes, administrators would do well to address significant time demands facing their nursing staff. Furthermore, since one potential driver of nursing engagement is supportive nurse management, administrators should focus on hiring and training supportive nurse managers to augment their success.

Figure 4. Analytic framework for relationships among work system factors, emotional exhaustion, engagement and patient falls

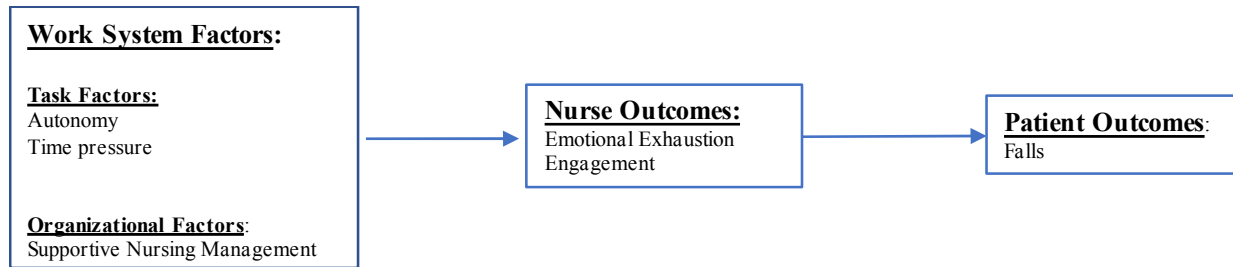


Table 3. Data source and collection information

Variable (# items)	Instrument/ Source	Collection Timeframe	Overall Response Rate	Reported reliability (Cronbach's α)	Data Collection Method
EE (5)	Maslach Burnout Inventory (MBI)	March 9, 2015-April 6, 2015	5158/8123 63%	$\alpha = .89$ [41]	Multi-modal: paper, web-token and email
Autonomy (3) Time pressure (3) Supportive Nursing Management (3)	National Database of Nursing (NDNQI) RN Survey	April 6-26, 2015	1904/2763 69%	$\alpha = .74$ [19] $\alpha = .80$ [19] $\alpha = .84$ [20]	Email sent to all direct care nurses employed > three months prior to survey
Employee Engagement (12)	Gallup Q ¹²	March 9-29, 2015	6747/10,3 99 65%	$\alpha = .88$ [22]	Email sent to all direct care nurses working > 20 hours/week and employed > 4 weeks prior to survey
Average length of nurse employment Percentage of RN FTEs BSN or higher	Operational Database	Fiscal year 2015	NA	NA	Nurse reported
Patient falls	Operational Database	July- September 2015	NA	NA	Manual collection quarterly by trained hospital staff

Table 4. Association of work system factors with nurse outcomes

WSF Mean Score (SD)	Association with Burnout n=62				Association with Engagement n=64			
	SLR Estimate (95% CI)	Effect Size	MLR Estimate (95% CI)	Standardized Estimate	SLR Estimate (95% CI)	Effect Size	MLR Estimate (95% CI)	Standardized Estimate
Autonomy 4.23 (0.43)	-4.66* (-6.12, - 3.19)	.40	1.52 (-.67, 3.72)	0.21	0.51* (0.39, 0.63)	.56	0.16 (-0.06, 0.39)	0.24
Time pressure 4.36 (0.51)	-4.93* (-5.81, - 4.05)	.68	-5.44* (-7.02, - 3.87)	-0.91	0.41* (0.31, 0.51)	.51	0.15 (-0.01, 0.32)	0.27
Supportive nursing management 4.59 (0.6)	-2.34* (-3.51, - 1.17)	.21	-0.51 (-1.59, 0.58)	-0.1	0.35* (0.26, 0.44)	.51	0.19* (0.07, 0.3)	0.38

Note. * p value <.05, WSF= Work System Factor, SLR=Simple Linear Regression, MLR=Multiple Linear Regression

Table 5. Tests of mediation of work system factors on patient fall rates by burnout and engagement

Analysis with Burnout n=45	Model 1			Model 2			Model 3		
	Estimate	SE	P value	Estimate	SE	P value	Estimate	SE	P Value
Autonomy	0.94	0.38	0.88				1.11	0.50	0.80
Burnout				1.02	0.06	0.66	1.04	0.06	0.57
Time pressure	0.92	0.31	0.80				1.06	0.54	0.90
Burnout				1.02	0.06	0.66	1.03	0.08	0.65
Supportive nursing management	1.17	0.27	0.49				1.50	0.43	0.16
Burnout				1.02	0.06	0.66	1.08	0.07	0.21
Analysis with Engagement n=45									
Autonomy	0.94	0.38	0.88				1.05	0.48	0.92
Engagement				0.85	0.43	0.76	0.82	0.50	0.74
Time pressure	0.92	0.31	0.80				0.96	0.40	0.93
Engagement				0.85	0.43	0.76	0.89	0.54	0.85
Supportive nursing management	1.17	0.27	0.49				1.55	0.48	0.15
Engagement				0.85	0.43	0.76	0.45	0.28	0.19

Note. All models are adjusted for unit type, average length of nurse employment, and percentage of nurses with bachelor's degree or higher

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CHAPTER 3: ADDENDUM

In addition to our original planned analysis, we performed post-hoc analysis to explore the possibility of several additional relationships among our variables of interest. In our unadjusted analysis, we found that both time pressure and burnout had a significant relationship with patient falls. In our adjusted analysis, these relationships were no longer significant. It is possible that our adjustment variables accounted for the variability in our data. But it is also possible that an alternative model better explained the relationship among the variables, for example perhaps there was an interaction among variables. Our post-hoc analysis focused on exploring alternative possible relationships between time pressure, burnout and patient falls.

In our first post-hoc analysis, we considered the possibility of an interaction effect between unit type and any of our covariates. Given that we found some significant relationships in unadjusted analysis but not when adjusted for unit type, we were interested in exploring if there was a different relationship for our variables of interest in high risk units then there was in low risk units. Unit type was characterized by a dichotomous variable to capture low risk versus high risk unit types. Low risk units included patient populations that were typically non-ambulatory, or ambulatory patients who were less medically complex. Examples included critical care units, psychiatric units, and labor and delivery. High risk units included ambulatory medically complex patient populations, and included Medical, Surgical, and Neurosurgical units. We stratified our sample into high and low fall risk unit types to explore relationships between our independent variables that differed by unit type.

Findings

After stratifying our sample, we re-ran our mediation models in both high risk and

low risk fall units (Table 6 & 7). Model one evaluated the relationship between work system factors and patient falls. Model two evaluated the relationship between nurse outcomes (burnout or engagement) with patient falls. Model three included both work system factors and nurse outcomes on patient falls. All of our models were adjusted for average length of nurse employment and percent of unit staff with bachelor's degree or higher. Within these models, we looked for covariates with significance as a potential signal of an interaction between unit type and covariates. We did not find any significant covariates in this analysis.

Table 6. Stratified analysis (High fall risk units only) of potential mediated relationship of patient falls and work system factors by burnout and engagement

Analysis with	Model 1			Model 2			Model 3		
	Estimate	SE	P value	Estimate	SE	P value	Estimate	SE	P Value
Analysis with Burnout n=26									
Autonomy	0.84	0.42	0.73				1.08	0.71	0.90
Burnout				1.04	0.07	0.60	1.05	0.09	0.60
Time pressure	0.84	0.31	0.63				0.92	0.56	0.89
Burnout				1.04	0.07	0.60	1.02	0.11	0.83
Supportive nursing management	1.21	0.35	0.51				1.79	0.60	0.08
Burnout				1.04	0.07	0.60	1.13	0.08	0.10
Analysis with Engagement n=26									
Autonomy	0.84	0.42	0.73				0.95	0.61	0.94
Engagement				0.78	0.47	0.68	0.81	0.65	0.80
Time pressure	0.84	0.31	0.63				0.83	0.38	0.69
Engagement				0.78	0.47	0.68	1.01	0.74	0.99
Supportive nursing management	1.21	0.35	0.51				1.79	0.65	0.11
Engagement				0.78	0.47	0.68	0.34	0.23	0.11

Note. All models adjusted to for average length of nurse employment and percent of unit staff with bachelor's degree or higher

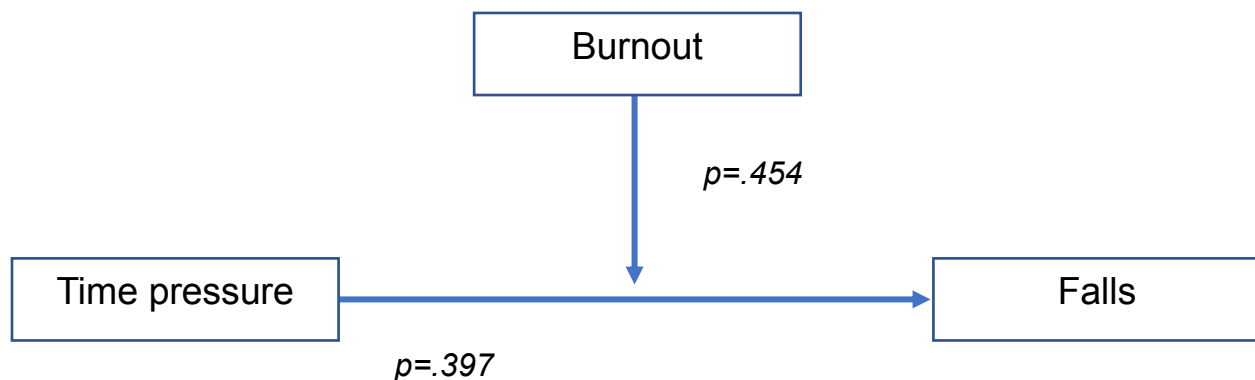
Table 7. Stratified analysis (low fall risk units only) of potential mediated relationship of patient falls and work system factors by burnout and engagement

Analysis with	Model 1			Model 2			Model 3		
	Estimate	SE	P value	Estimate	SE	P value	Estimate	SE	P Value
Analysis with Burnout n=19									
Autonomy	0.99	0.37	0.98				0.85	0.38	0.71
Burnout				1.02	0.05	0.67	1.04	0.06	0.47
Time pressure	0.87	0.25	0.62				0.59	0.23	0.18
Burnout				1.02	0.05	0.67	0.97	0.07	0.73
Supportive nursing management	1.04	0.23	0.87				1.22	0.46	0.59
Burnout				1.02	0.05	0.67	1.09	0.08	0.26
Analysis with Engagement n=19									
Autonomy	0.99	0.37	0.98				0.82	0.46	0.72
Engagement				0.85	0.35	0.69	0.79	0.48	0.70
Time pressure	0.87	0.25	0.62				0.62	0.28	0.30
Engagement				0.85	0.35	0.69	1.27	0.92	0.75
Supportive nursing management	1.04	0.23	0.87				1.25	0.41	0.49
Engagement				0.85	0.35	0.69	0.48	0.24	0.15

Note. All models adjusted to for average length of nurse employment and percent of unit staff with bachelor's degree or higher

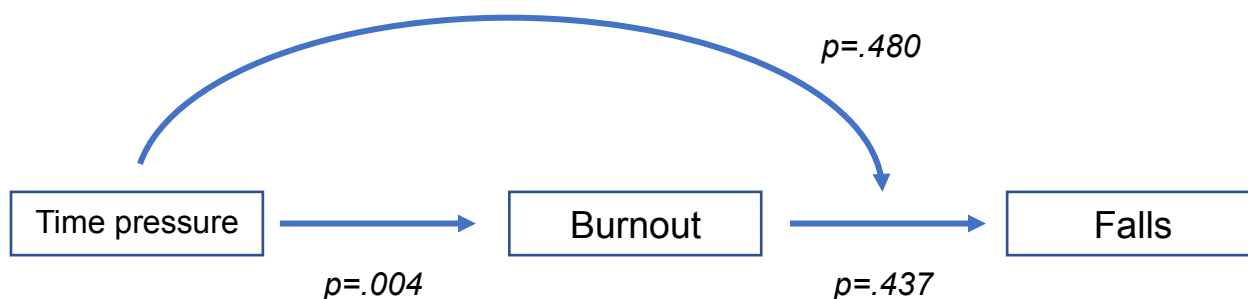
Next, we explored the possibility of an interaction effect between burnout and time pressure (Figure 5). We hypothesized that at different levels of burnout, time pressure may have a greater or lesser effect. This model included an interaction term for burnout and time pressure and we adjusted for unit type, average length of nurse employment and percent of unit staff with bachelor's degree or higher. We did not find that an interaction effect existed between burnout and time pressure.

Figure 5. Evaluation of interaction effect between time pressure and burnout



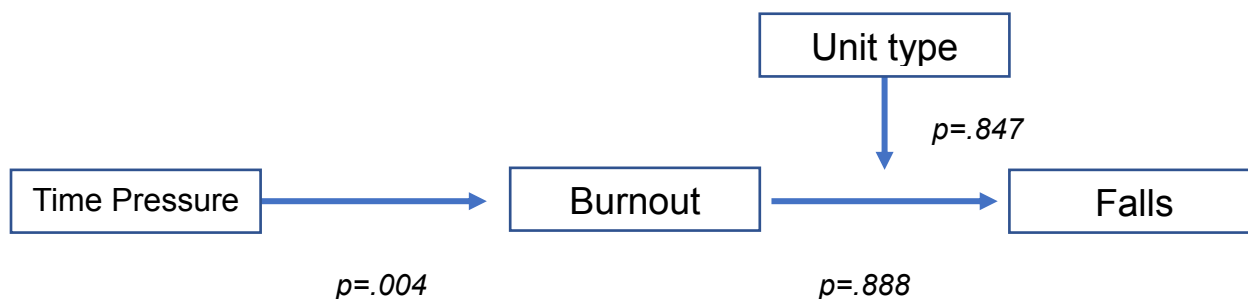
We thought that it was possible our variables of interest had more complex relationships than traditional mediation or moderation given the complex work environment within which nurses practice. Our next post-hoc analysis explored the several types of moderated mediation relationships among our variables. In our first model, we explored whether different levels of time pressure moderated the relationship between burnout and falls (Figure 6). In this model, time pressure is both independent variable and moderator, burnout is a mediator and patient falls is the outcome variable. As noted earlier, time pressure has a significant relationship with burnout ($p=0.004$) but we did not find a significant relationship for time pressure as a moderator and burnout did not have a significant relationship with falls in this model.

Figure 6. Model 1 of moderated mediation of patient falls by time pressure and burnout



To extend our stratified analysis, our next moderated mediation model explored the possibility of unit type as a moderator of the mediated relationship between time pressure, burnout, and patient falls, extending our stratified analysis (Figure 7). In this model, burnout still mediates the relationship between time pressure and patient falls, but the relationship changes based on unit type. Similar to our stratified analysis, we did not find any evidence for a significant difference in the relationship based on the moderating effect of unit type.

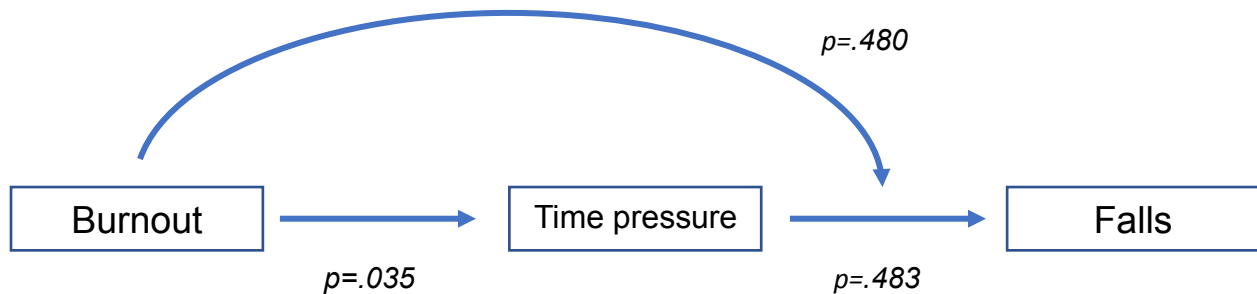
Figure 7. Model 2 of moderated mediation of patient falls by time pressure and burnout



Finally, we assessed the possibility that the relationship between time pressure and burnout were reversed. We re-evaluated both of our moderated mediation models reversing the placement of time pressure and burnout. First, we wanted to test whether burnout was moderating the relationship between time pressure and patient falls (Figure 8). As in all previous models, we adjusted for length of nurse employment and percent of nurses who had a bachelor's degree or higher on the unit. We did not find that reversing the

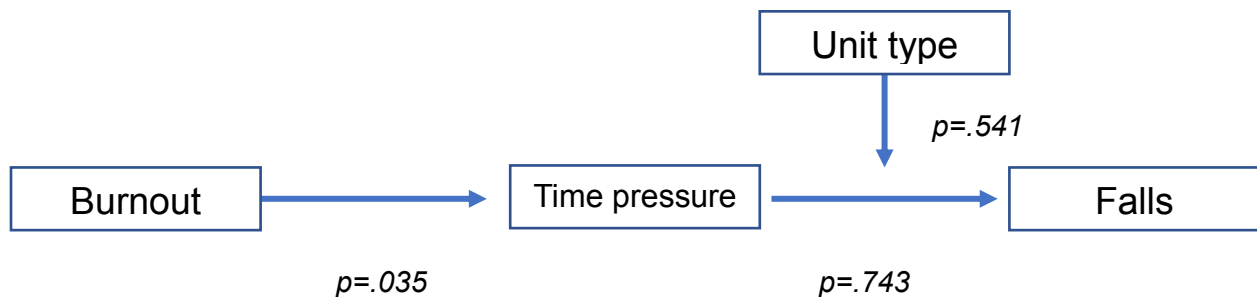
order of the relationship between time pressure and burnout revealed a significant relationship with patient falls.

Figure 8. Model 3 of moderated mediation of patient falls by time pressure and burnout



In our final moderated mediation model, we included unit type as the moderator of the mediated relationship between burnout and patient falls (Figure 9). This model is a replica of model 2, but with burnout and time pressure reversed. It also includes adjustment for average length of nurse employment and percent of nurses with a bachelor's degree or higher. We did not find that unit type moderated this relationship either.

Figure 9. Model 4 of moderated mediation of patient falls by time pressure and burnout



Conclusion

Our extended analysis of these complex relationships did not find a mediation, moderation, or moderated mediation relationship among these variables. In our sample, it appears that our covariates (unit type, length of nurse employment, and percent of nurses with bachelor's degree or higher) account for the variation in fall rates. Previous research

has shown that these variables are important to patient outcomes.[1–3]

There are some limitations to our analysis that should be noted. Our data was essentially cross-sectional with burnout and time pressure collected within a month of each other, although our outcome variable, patient falls, was collected at a later time point. Future studies exploring these relationships should include a longitudinal design such that temporality for mediation is clearly aligned. Additionally, a variable that accounts for more nuanced differences in unit type than our variable of dichotomous fall risk unit type should be investigated.

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CHAPTER 4: MANUSCRIPT THREE

The Comprehensive Unit-based Safety Program is associated with increased employee engagement

Abstract

Objective: To assess association between Comprehensive Unit-based Safety Program (CUSP) implementation with nurse autonomy, time pressure, supportive nursing management, burnout and engagement in inpatient hospital units.

Background: CUSP is a quality improvement method designed to facilitate identification and resolution of safety issues with clinical staff. CUSP is widely adopted throughout the US and is becoming more prevalent internationally. CUSP has positive clinical effects, notably in decreasing central line associated blood stream infections and ventilator acquired pneumonia in units where it has been implemented. CUSP's impact on organizational and employee outcomes is less well known.

Methods: We used an internally developed measure of CUSP implementation consisting of ten variables corresponding with CUSP implementation over a six-month period. We used multivariable regression to estimate relationships with five outcome variables (autonomy, time pressure, supportive nursing management, burnout and engagement) aggregated at the unit level. We evaluated overall F test for significance and the coefficient of determination as an estimate of effect size.

Results: In our sample of 37 units, we observed a statistically significant relationship between CUSP implementation and engagement ($p=0.05$, $R^2=0.55$). Effect sizes between CUSP and burnout and time pressure were moderately sized ($R^2=0.5$ and $R^2=0.49$ respectively) but not statistically significant. Effect sizes between CUSP and autonomy and supportive nursing management were smaller ($R^2=0.38$ and $R^2=0.34$ respectively) and not statistically significant.

Conclusion: This exploratory study suggests that implementation of CUSP on inpatient hospital units is associated with increased levels of nurse engagement. Further research exploring this relationship is warranted.

Introduction

The IOM report “To Err is Human” marked a turning point in patient safety in healthcare.[1] Despite the large amount of work to enhance patient safety since this watershed report, improvement has been incremental.[2] One intervention with positive impact is the Comprehensive Unit-based Safety Program (CUSP).

CUSP is an adaptive intervention widely adopted in the United States and internationally.[3–7] CUSP was developed in intensive care units (ICUs) at Johns Hopkins Hospital.[8] CUSP serves as a mechanism by which staff identify and resolve safety issues at the point of care. Since its origin, CUSP has evolved to a five step process: baseline culture assessment, staff safety training, identification of staff concerns, partnership with senior executives, and learning from defects.[8–11]

CUSP is a powerful tool for implementing and sustaining improvements in patient safety. The use of CUSP combined with evidence-based infection control guidelines in the Michigan Keystone initiative showed significant and sustained reductions in central line associated blood stream infection rates in ICUs.[12] Several additional studies have further replicated these results throughout the country.[3,5,11,13] CUSP does have potential limits however. In an attempt to replicate the results from Michigan, CUSP was implemented in ICUs across England. The authors attributed the significant decrease in blood stream infections over the course of the study to a secular trend in system-wide improvements rather than purely to CUSP implementation.[6]

CUSP has been shown to improve some non-clinical outcomes. The focus within CUSP on improvement of communication and teamwork has been shown to improve patient safety culture.[8,10] It has been shown to reduce nurse turnover in units where it

has been implemented.[8,10] More recently, CUSP has been linked to a positive effect on patient experience.[14]

The Systems Engineering for Improving Patient Safety (SEIPS) model provides a theoretical framework the impact of quality improvement (QI) on the organizational work system. This model suggests that in addition to traditional clinical outcomes, QI impacts both work system factors and employee outcomes.[15] Given this theoretical support, we were interested in assessing the extent to which CUSP implementation was associated with nurse perceptions of autonomy, time pressure, supportive nursing management, burnout and engagement on inpatient hospital units. We hypothesized that among units with higher levels of CUSP implementation, there would be higher levels of autonomy, supportive nursing management and nurse engagement, and lower levels of time pressure and nurse burnout (Figure 1).

Methods

This study took place in an 1100 bed tertiary hospital in the Mid-Atlantic region of the United States, using existing data from five operational databases (Table 8). This hospital includes a range of medical, surgical and specialty units which have participated in CUSP for differing amounts of time.

Over the last fifteen years, our organization has implemented CUSP throughout the hospital. As CUSP has spread, the hospital has sought to identify methods to measure CUSP implementation. To this end, a CUSP scorecard was developed and used to track CUSP implementation (Table 9). This scorecard was created by a group of clinicians and researchers with expertise in both CUSP and measurement methods.

After pilot testing and adjustment, the scorecard was employed throughout the organization.

The CUSP variables were collected for the time period of July-December 2014. The scorecard produces individual scores for each variable, which are not intended to be averaged or summed. Variables include percentage of meetings completed, percentage of meetings with executive leader attendance, percentage of meetings with physician champion attendance, an indicator of unit staff training in the science of safety within the last two years, an indicator of CUSP champion safety training, the average weekly protected hours for the CUSP champion to work on CUSP projects, the number of defects learned from, the number of data-driven improvement plans in effect, the average percent positive on the safety climate domain of the Safety Attitudes Questionnaire (SAQ), and the response rate to the SAQ.

Association of CUSP implementation with five nursing outcomes was evaluated: autonomy, time pressure, supportive nursing management, burnout and engagement. Data for these variables were collected between March-April 2015. Data for autonomy, time pressure and supportive nursing management were obtained via the National Database of Nursing Quality Indicators (NDNQI) RN Survey.[16,17] An adapted five-item version of the emotional exhaustion subscale of the Maslach Burnout Inventory (MBI) was used to measure emotional exhaustion.[18] The Gallup Q¹² survey was used to measure engagement.

Analysis was completed at the unit level. Data from the RN Survey items and Gallup Q¹² are typically aggregated for analysis and were only available to the

researchers at the unit aggregate level.[16,19] The ICC (1, k) was used to evaluate internal consistency of MBI data for unit-level aggregation.

We used multivariable regression to estimate associations. We included all CUSP variables in the regression equation simultaneously as explanatory variables and evaluated the overall F test for statistical significance, and the coefficient of determination for effect size. Amount of time since initiating CUSP was included as a covariate. Analysis focused on interpretation of associated effect sizes between CUSP and each outcome variable.

Results

Descriptive data is presented in Table 9. After merging databases, complete data for all variables (except emotional exhaustion where n=35) was available for 37 units. Mean length of CUSP participation was 5.1 years (SD=4.4 years). The variable for weekly dedicated CUSP champion work time had two significant outliers. These were included in the full analysis and a sensitivity analysis was performed without these units to assess their influence.

We found effect sizes ranging from small to moderate (Table 10). The largest effect size was between CUSP and nurse engagement ($R^2=0.55$) and was statistically significant ($p=0.05$). Relationships between CUSP and both emotional exhaustion and time pressure were moderately sized ($R^2=0.5$ and $R^2=0.49$ respectively). The association between CUSP with both autonomy and supportive nursing management had smaller effect sizes ($R^2=0.38$ and $R^2=0.34$ respectively). Statistical significance did not change during sensitivity analysis, and there were marginal changes to effect sizes.

Discussion

Our finding that CUSP implementation had a significant association with engagement and a moderate effect size aligns with research reporting that nurses working on hospital units where a QI program had been initiated had higher engagement scores compared to nurses working on units where the program had not been implemented.[20] Identifying antecedents to engagement is important, as research has identified a number of positive outcomes associated with engaged employees. Outside of healthcare, higher levels of employee engagement are associated with increased customer satisfaction, productivity, job performance, profit, employee retention and employee safety.[21,22] Within healthcare, engagement has been linked with higher job satisfaction, compassion satisfaction, care quality, and lower intent to leave nursing.[23] This finding is also timely as hospitals explore methods to increase employee engagement.[24]

However, not all research shows that QI has a positive impact on engagement in healthcare. A recent systematic review exploring the impact of lean QI methods found no impact on employee engagement, and a negative impact on worker satisfaction.[25] Mixed evidence for the association between QI and engagement may be due to differences in core approach for distinct QI models or clinician views of discrete QI methods. QI has not always been well received by clinicians, at times considered an infringement on professional control over practice and an added burden on already over-taxed clinicians.[26]

The Job Demands-Resource model suggests that working conditions affect motivation and employee health.[28] Job demands negatively impact employee

engagement and increase burnout, while job resources increase engagement and decrease burnout. Demands and resources can be physical, psychological, social or organizational aspects of the job. QI has been described as both a job demand and a job resource in healthcare.[20,29] This distinction may be differentiated by the driving force behind the QI project, i.e. whether it is a top-down or bottom-up initiative. In situations where the initiative is viewed as top-down it may be considered by clinicians to be a job demand while in situations where it is viewed as bottom-up it may be considered a resource. Lean tends to be a top-down initiative, while CUSP is meant to be driven by clinicians, although this is not always the case. In their ethnographic study exploring the Matching Michigan program, researchers indicated that in some cases, CUSP implementation was seen as an externally mandated initiative which decreased clinician interest in participation.[27] They suggested that this contributed to the program's failure to perform as anticipated.[27]

We found moderate effect sizes in the association between CUSP and both emotional exhaustion, and time pressure although neither was statistically significant. In general, increases in CUSP scorecard variables were associated with lower levels of emotional exhaustion in nursing staff and decreased perceptions of time pressure. This also aligns with CUSP being viewed as a job resource rather than a job demand.

There was a smaller association between CUSP and both autonomy and supportive nursing management. In general, as CUSP implementation variables increased, both autonomy and supportive nursing management increased. Several possibilities could explain the smaller effect size between CUSP implementation and autonomy. There may be a ceiling effect due to existing high levels of autonomy.

Another possible explanation may be that nurse level of involvement in CUSP moderates the relationship. Nurses who are deeply involved in the CUSP process of identifying defects and determining solutions are likely to view CUSP as increasing professional autonomy. However, nurses not as engaged in the CUSP process, but required to implement solutions identified by the CUSP team, could view CUSP as having a negative impact on autonomy. Qualitative or mixed methods research exploring these relationships may provide clarity.

The smaller association between CUSP and supportive nursing management is not entirely unexpected. CUSP is intended to be a staff driven process. Nurse managers are involved in facilitating projects, but ultimate responsibility rests with staff. While not absent, the nurse manager's role in CUSP is not necessarily central to the project.

Limitations

Some limitations apply. This was exploratory research, as we anticipated a small sample size. However, even with the exploratory nature of the research, we identified moderate effect sizes for several associations and a significant relationship with engagement. Selection bias may have inflated the association between CUSP and engagement as units self-select to become CUSP units, indicating a potential for this group to have higher engagement levels. Generalizability of this research may be limited because it was conducted in a single, tertiary care hospital. Finally, while face validity of the CUSP scorecard was established during creation, other forms of validity have not been verified. The CUSP scorecard is a practical tool that was developed for

monitoring and evaluating CUSP team performance, and would benefit from ongoing refinement to better establish its utility in research.

Conclusion

CUSP has been shown to have a significant positive effect on clinical outcomes. There is limited research exploring its association with work system factors and employee outcomes. We found preliminary support that CUSP is positively associated with employee engagement. Further we found small to moderate effect sizes in the association of CUSP with autonomy, time pressure, supportive nursing management and emotional exhaustion. This study provides a foundation for future research seeking to understand the broader impact of CUSP implementation beyond clinical outcomes.

Figure 10. Proposed research relationships CUSP, work system factors and nurse outcomes

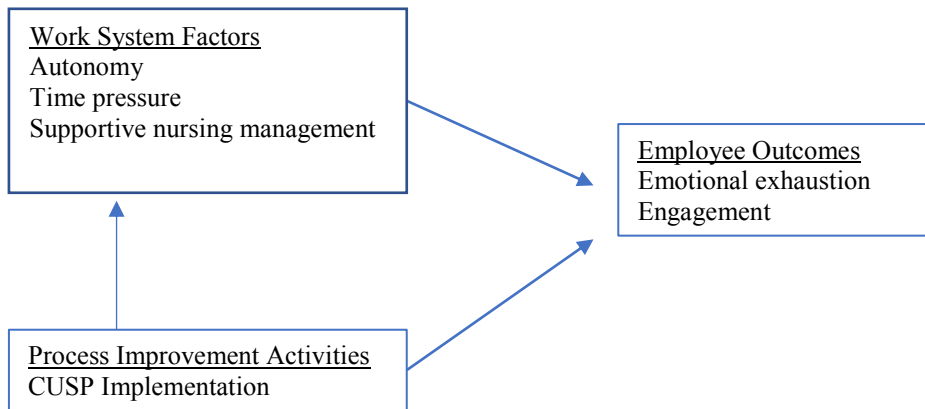


Table 8. Data source and collection information

Variable (# items)	Instrument	Collection Timeframe	Response Rate	Reliability	Data Collection
Emotional exhaustion (5)	Emotional exhaustion from Maslach Burnout Inventory (MBI)	March 9, 2015- April 6, 2015	5158/8123 63%	$\alpha = .89[30]$	Multi-modal: paper, web- token, email
Autonomy (3) Time adequacy (3) Supportive Nursing Management (3)	National Database of Nursing (NDNQI) RN Survey	April 6-26, 2015	1904/2763 69%	$\alpha = .74[16]$ $\alpha = .80[16]$ $\alpha = .84[17]$	Email invitation and link to all direct care nurses employed > three months prior to survey
Employee Engagement (12)	Gallup Q ¹²	March 9-29, 2015	6747/10,399 65%	$\alpha = .88[19]$	Email invitation and link, to all direct care nurses working > 20 hours/week and employed > 4 weeks prior to survey
CUSP Implementation (10)	CUSP Scorecard	July-December 2014	45/45* 100%	NA	Spreadsheet entry CUSP champion

Note. *CUSP response rate is at the unit level

Table 9. Research Variables

	Response range	Mean	SD
CUSP implementation variables			
Percentage of scheduled meetings held	50-100%	88%	14%
Percentage of meetings with Executive Champion attendance	0-100%	34%	31%
Percentage of meetings with Physician Champion attendance	0-100%	37%	36%
Percentage of unit staff who completed science of safety training within prior two years	0-100%	72%	33%
Unit CUSP champion safety training (0=none, 1=one training, and 2=both trainings completed)	Categorical: 0-3	1	0.72
CUSP champion average weekly CUSP hours	0-20 hours	2.6	4.0
Number of defects leading to a system change or new process developed	0-9	3.0	2.3
Number of data driven improvement plans	0-9	3.2	2.1
Average percent positive score for safety climate domain of the SAQ	37-100%	71%	13%
Unit response rate for SAQ	56-100%	75%	13%
Covariates			
Length of time since CUSP initiation (years)	0-12.7	5.1	4.4
Outcome Variables			
Autonomy	3.2-5.2	4.2	0.4
Time pressure	2.9-.53	4.4	0.5
Supportive nursing management	2.9-5.6	4.6	0.6
Emotional exhaustion	8.3-21.9	14.5	3.1
Engagement	3.3-4.5	3.9	0.3

Table 10. Estimated effect sizes

	F test p value	R² Full Model n=37*	R² Sensitivity n=35*
Autonomy	0.32	0.38	0.41
Time pressure	0.08	0.49	0.53
Supportive nursing management	0.48	0.33	0.36
Emotional exhaustion	0.07	0.50	0.55
Engagement	0.05	0.55	0.55

Note. *n=35 units in emotional exhaustion analysis full model and n=33 units in emotional exhaustion sensitivity analysis. All models adjusted to include length of time since CUSP implementation.

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CHAPTER 5: SYNTHESIS/DISCUSSION

Introduction

This study exploring the predictors and impact of nurse burnout and engagement using operational unit-level hospital data provides some important insights into these employee outcomes that are relevant to a wide-ranging audience. This chapter will provide a summary of findings by aim, discuss research limitations, suggest potential implications for practice, and policy, and conclude with recommendations for future research.

Summary of Findings

The study sample included 64 units from an 1100 bed inpatient hospital in Baltimore, Maryland. Data were obtained from five internal hospital operational databases, cleaned and merged for analysis. Data for aim one (work system factors and nurse outcomes) was collected between March and April of 2015. Aim two supplemented the data from aim one with unit-aggregated patient fall rates collected from July to September 2015. Data for aim three supplemented the data from aim one with CUSP implementation data from July to December 2014.

Aim 1

The goal of aim one was to determine which work system factors (autonomy, time pressure, supportive nursing management) were associated with burnout and engagement on inpatient nursing units. Linear regression was used to test aim one with results presented in Table 11.

In bivariate analysis, all work system factors were significantly related to both burnout and engagement after adjusting for unit-based average length of employment, and percent of nurses with a bachelor's degree or higher. In adjusted multivariable

analysis only time pressure remained significantly related to burnout and only supportive nurse management remained significantly related to engagement. Standardized coefficients showed that time pressure had the largest impact on burnout and supportive nurse management had the largest impact on engagement.

Table 11. Association of Work System Factors with Nurse Burnout and Engagement

Work System Factor	SLR Coefficient	MLR Coefficient	β	SLR Coefficient	MLR Coefficient	β
Autonomy	-4.34*	1.52		0.51*	0.16	
Time pressure	-4.80*	-5.44*		0.41*	0.15	
Supportive nurse management	-2.42*	-0.51		0.35*	0.19*	

Note. * $p < 0.05$, SLR= Simple Linear Regression, MLR= Multiple Linear Regression, β = standardized beta coefficient, results are adjusted for average length of employment and level of education

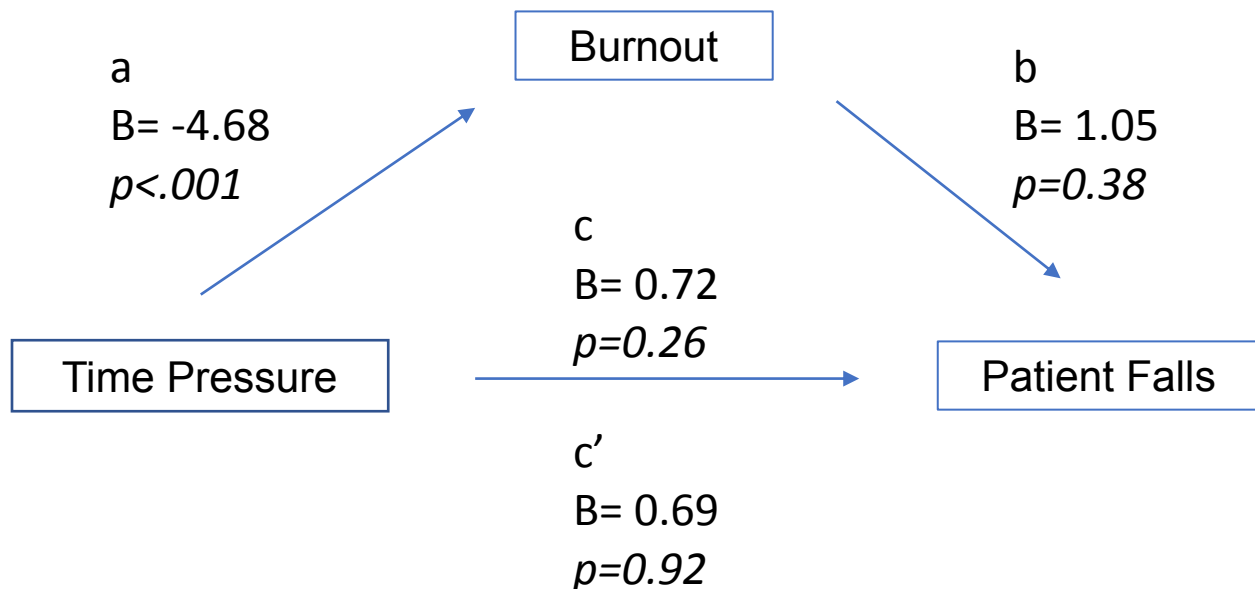
Aim 2

In aim two, we sought to assess if either burnout or engagement mediated the relationship between work system factors and patient falls. We hypothesized that units with lower levels of work system factors (less autonomy, more time pressure, and less nurse manager support) would have higher levels of burnout which would be associated with higher fall rates. Further, we hypothesized that units with lower levels of work system factors (less autonomy, more time pressure, and less nurse manager support) would have lower levels of engagement and higher fall rates.

To test these hypotheses, we used negative binomial regression with Baron and Kenny's approach for mediation with and without covariates.[1] In unadjusted analysis, of the three work system factors tested, we found that only time pressure was associated with patient fall rates ($p=.049$). Of the nurse outcomes, we found that burnout was associated

with patient fall rates but that engagement as not ($p=.024$, $p=.18$). In our final unadjusted model, we did not find that burnout mediated the relationship between time pressure and fall rates (Figure 11). When we adjusted for unit type, average length of employment and percent of nurses with a bachelor's degree or higher, we found that none of our variables were significantly related to patient fall rates.

Figure 11. Analysis of burnout mediation of time pressure on patient falls



Note.

- a= results of linear regression controlling for unit type, average length of nurse employment and percent of nurses with a bachelor's degree or higher
- b & c= results of negative binomial regression controlling for unit type, average length of nurse employment and percent of nurses with a bachelor's degree or higher
- c'= results of negative binomial regression controlling for unit type, average length of nurse employment, percent of nurses with a bachelor's degree or higher, and burnout
- B= unstandardized regression coefficient

In post-hoc analysis, we explored alternative relationships between time pressure, burnout and falls. We did not find an interaction effect between time pressure and burnout. We further did not find evidence for a moderated mediation effect within our sample. Our models tested for an interaction effect by both time pressure and

burnout with each alternatively explored as the mediator of falls. Finally, we tested for effect modification by unit type of the mediated relationships among time pressure, burnout and falls. We did not find that these relationships were significant. All of our models adjusted for length of nurse employment, and percent of nurses with a bachelor's degree or higher on the unit. Where applicable, we also adjusted for unit type.

Aim 3

In aim three we explored the extent to which CUSP implementation was associated with work system factors (autonomy, time pressure, and supportive nursing management) and nurse outcomes (burnout and engagement). Due to limitations of sample size, our analysis was exploratory in nature. We found that effect sizes ranged from small to moderate (Table 12). Engagement was the only variable found to have a statistically significant relationship with CUSP implementation in our sample.

Table 12. Effect sizes of relationship between CUSP and work system factors (autonomy, time pressure and supportive nursing management) and nurse outcomes (burnout and engagement)

	F test p value	R² n=37
Autonomy	0.32	0.38
Time Adequacy	0.08	0.49
Supportive Nursing Management	0.48	0.33
Burnout	0.07	0.50
Engagement	0.05	0.55

Discussion

Strengths and Limitations

One of the strengths of this study was its novel use of internal operational data from multiple data sources. Hospitals and health systems collect myriad data for internal operations. To use this data for research purposes requires merging of datasets, which has inherent challenges, however there is much value to be gained from this approach. It can provide some preliminary data to justify a larger study, or expanded data collection for future research.

Using existing data does pose some limitations. The research is limited to the variables that are available for analysis and may not include all necessary covariates. However, there are occasionally novel ways to address these limitations. Initially, we did not include unit type as a covariate as our sample size could not support the large number (thirteen) of unit types in our sample. To address this, we decided to create a dichotomous unit type indicator that characterized units by their potential fall risk as high or low.

Another challenge of merging existing operational data is the inability to link data at the individual level for analysis. The datasets that we used are anonymous and do not include individual identifiers. Because of this, we are unable to analyze the data at the individual level. We found however that unit level aggregation of data was justified in our dataset and does provide a novel way to exploring both burnout and engagement. Evidence exists for the contagious nature of burnout among nurses providing further justification for analysis of this concept at the unit level.[2]

Another limitation worth noting was that we were somewhat limited in our final sample size of data available for analysis. After cleaning and merging data, there were a

number of units that only collected data for some of the datasets, and did not have complete data available for analysis. This decreased our sample size to lower than anticipated. Given this challenge however, we were able still able to establish the existence of some relationships among our variables of interest, a strength of this research.

Implications for Nursing

The results of this research have important implications for nursing practice, and health policy. This research has relevance to multiple audiences within the hospital, including bedside nurses, nurse managers and hospital administrators. At the individual nurse level, it is important for nurses to identify personal risk for burnout and incumbent upon them to address those risks when identified and within their means. While individual nurses may not have the authority to address systematic issues of time pressure in their daily work, they are certainly the expert in identifying situations where time pressures exist. Given this critical information and knowing that increased time pressure is associated with increased burnout, they can advocate for addressing these systematic instances of increased time pressure in their work.

Findings from this research could impact the patient assignment process by charge nurses. Knowledge that time pressure is associated with burnout levels in nurses should prompt charge nurses to minimize factors which increase time pressure for nurses when making assignments. Specific example include turbulence, or the amount of Admissions, Discharges and Transfers (ADT) that each nurse must address on his/her shift.[3,4] Although generally common practice in staffing currently, this research further justifies the practice of taking into account variability of patient acuity level within each nurse's assignment and potentially decreasing number of assigned patients when acuity levels are

greater than normal. Charge nurses should also account for differences in experience level among nurses, as less experienced nurses may have difficulty prioritizing task shortening in the setting of increased time pressure.[5] Researchers found that inexperienced nurses decreased the number of double checks they performed in the face of increased time pressures and dispersed attention during dual tasking, a practice which may lead to an increased likelihood of errors.[5]

This research is also applicable to nurse managers and administrators as they consider methods to minimize burnout or increase engagement. As addressed earlier, that burnout can be considered a unit level construct and is impacted by organizational level variables implies that individually-focused interventions are not sufficient to prevent or treat burnout. As charge nurses address day-to-day variables that impact the experience of time pressure by nurses, nurse managers and administrators must address higher-level variables that could decrease the experience of time pressure by nurses. Most prominently, this involves setting appropriate staffing ratios within their unit or organization and building a clear business case to support appropriate staffing.

This study also provides hospital administrators data illustrating the critical importance of the role of the nurse manager. Recent evidence shows that leadership practices of nurse managers are associated with patient satisfaction, mortality, medication errors, restraint use, and hospital-acquired infections.[6] Our research further cements the importance of this role through its link to nurse engagement. Historically, nurses were promoted to nurse manager positions based on their clinical acumen, not necessarily their strengths as a leader. Education requirements and training for this role vary from hospital to hospital, with some requiring a master's degree, while others have no degree

requirements.[7] Instituting education and training requirements beyond clinical skill will increase the likelihood that nurses in these roles are appropriately prepared to fill this critical position. To maximize the potential positive impact of nurse managers, Administrators should evaluate current education requirements for nurse managers, as well as assessing the training and support that their hospital provides to those in this role.

This research adds to current policy discussions in healthcare around nurse staffing. Nationally, there is not a mandate for nurse staffing, although Medicare regulations do require that participating hospitals have “adequate” numbers of nurses to care for patients “as needed”.[8] To address this, some states have enacted legislation that dictates nurse staffing through mandated staffing ratios, mandated staffing committees, disclosure of staffing levels to the public or a regulatory agency, or some combination of these. Recognition that time pressure is associated with increased levels of burnout in nurses should be incorporated into these discussions as further justification of the need for careful consideration of staffing plans at the policy level.

Recommendations for Future Research

This research provides the foundation for exploration of several additional avenues of research moving forward. The clinical impact of CUSP on hospital acquired infections is clear and well documented.[9–13] Less well known is the impact of this intervention on nurse outcomes and nurse perceptions of their work environment (autonomy, time pressure, supportive nursing management), a gap we attempted to fill. Our preliminary data provides a basis for research in larger samples consisting of more diverse unit types to further explore these relationships given the effect sizes identified in our sample.

Further research seeking to better understand measures of CUSP implementation

would be beneficial. For example, seeking to understand if there is a threshold for the number of data driven projects a CUSP team completes or the number of defects a CUSP team addresses would be beneficial. Further, a measure that captures the quality of projects, rather than simply the quantity might better illustrate successful CUSP teams.

This sample was cross-sectional in nature. Future research exploring the longitudinal effects of time pressure on burnout would be beneficial to potentially infer causal relations. Multilevel modelling would allow for assessments of the interaction effect between individual burnout and unit.

There is currently not enough evidence to support any one staffing strategy for safe staffing in nursing. Further research exploring this could provide a substantial, important contribution to improving safety in hospitals. Further identification and exploration of unanticipated consequences of mandated staffing is important before widespread use of this strategy is implemented.

Summary

This study shows that work system factors have an important association with both burnout and engagement. Further, we see that CUSP implementation has a significant association with nurse engagement. While we did not find a link between work system factors, nurse outcomes and patient outcomes, other research has shown that nurse burnout has a negative impact on patient outcomes.[14] Deepening our understanding of factors that impact burnout at the unit level helps researchers begin to identify unit level targeted interventions to prevent and treat burnout.

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Appendices

Appendix A

NDNQI RN Survey Items



2014 NDNQI RN Survey with Job Satisfaction Scales-R[©]

The NDNQI® *RN Survey with Job Satisfaction Scales-R* contains selected items from the *NDNQI-Adapted Index of Work Satisfaction* (Stamps, 1997; Taunton et al., 2004), and *NDNQI-Adapted Nursing Work Index* (Aiken & Patrician, 2000). It also contains *Job Enjoyment* (adapted from Brayfield and Rothe, 1951; Taunton et al.), work context items, and nurse characteristic items.

The *Job Satisfaction Scales-R* is a revised version of the current *NDNQI-Adapted Job Satisfaction Scales*. The number of original items per subscale was reduced to streamline the measure while maintaining good evidence of reliability and validity. The *NDNQI Job Satisfaction Scales-R* includes the following subscales: *Task, Nurse-Nurse Interactions, Nurse-Physician Interactions, Decision-Making, Autonomy, Professional Status, Pay, Nurse Management, Nursing Administration, Professional Development Opportunity, and Professional Development Access*.

RN job satisfaction is measured at the unit level, just as all other indicators included in the NDNQI®. An important adaptation was the shift of the items from an individual focus to a nursing unit focus. This shift to a nursing unit focus supports the validity of the aggregated unit-level reports (Boyle, et al., 2006; Taunton, et al., 2004, Verran, et al., 1995). In other words, asking RNs about their unit and the RNs with whom they work is generally accepted as an appropriate approach to reporting the level of RN job satisfaction on a nursing unit.

Work context items relate to RN job plans, quality of care (Aiken, Clarke, & Sloane, 2002), ratings of the last shift worked, breaks (Rogers, Hwang, & Scott, 2004), and overtime. Items regarding breaks were adapted with permission from Dr. Ann Rogers. RN characteristic items include gender, race, age, tenure, and education.

Eligibility Criteria

Eligible RNs are full or part-time, regardless of job title, who spend at least 50% of their time in direct patient care, and have been employed a minimum of 3 months on the unit. Unit-based PRN or per-diem RNs employed by the hospital are eligible, agency or contract RNs are not eligible. See RN Survey Coordinator Data Collection Protocol for additional details.

NDNQI Member Reports

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All items and item response options are not included in the reports. For details regarding report contents, see the RN Survey Scoring and Glossary Guide document, available on your member website.

NDNQI Job Satisfaction Scales-R

Stem: Based on your experience, please indicate your agreement or disagreement with the following statements about your unit and the RNs with whom you work.

Response options: strongly agree, agree, tend to agree, tend to disagree, disagree, strongly disagree.

Task

1. RNs are satisfied with the nursing care we provide on our unit.
2. RNs on our unit have sufficient time for direct patient care.
3. RNs have plenty of opportunity to discuss patient care problems with each other on our unit.

Nurse-Nurse Interaction

1. RNs I work with count on each other to pitch in and help when things get busy.
2. There is a good deal of teamwork among RNs I work with.
3. RNs I work with support each other.

Nurse-Physician Interaction

1. In general, physicians cooperate with RNs on our unit.
2. There is a lot of teamwork between RNs and physicians on our unit.
3. Physicians at this hospital generally appreciate what RNs do.

Decision-Making

1. As RNs, we feel we have ample opportunity to participate in administrative decision-making.
2. As RNs, we have all the voice we want in planning policies and procedures for our unit.
3. Nursing administrators generally consult RNs on our unit about daily problems.

Autonomy

1. As RNs, we have sufficient input into the program of care for each of our patients.
2. RNs on our unit have a good deal of control over our own work.
3. As RNs, we are free to adjust our daily practice to fit patient needs.

Professional Status

1. RNs are satisfied with the status of nursing on our unit.
2. RNs recommend our unit as a good place to work.
3. Work contributes to a sense of personal achievement for RNs on our unit.

Pay

1. Our present salary is satisfactory to myself and RNs I work with.
2. Our pay is reasonable considering what is expected of RNs at this hospital.
3. Pay here is fair, compared to what we hear about RNs at other hospitals.

Professional Development Opportunity

1. RNs have career development opportunities on our unit.
2. RNs on our unit have support for pursuing nursing degrees.
3. RNs on our unit have opportunities for career advancement.

Professional Development Access

1. RNs on our unit have access to regional and national conferences.
2. On our unit, RNs have access to regular in-service programs.
3. RNs on our unit have access to continuing education.

Supportive Nursing Management

1. Our nurse manager is a good leader for our unit.
2. Our nurse manager is supportive of RNs on our unit.
3. Our nurse manager backs us in decision-making even in conflicts with physicians.

Nursing Administration

1. RNs on our unit are satisfied with the hospital chief nurse executive.
2. RNs on our unit view the hospital chief nursing executive as equal in authority to other top-level hospital executives.
3. Our hospital chief nurse executive is visible to myself and RNs I work with.

Appendix B

Gallup Q12 Survey

2015 JOHNS HOPKINS EMPLOYEE ENGAGEMENT SURVEY HELP SHEET

Welcome to the 2015 Johns Hopkins Employee Engagement Survey!

Johns Hopkins continues to work with Gallup, an independent consulting company, to conduct a workplace opinion survey to help improve your organization — the 2015 Johns Hopkins Employee Engagement Survey. The questions are designed to provide specific information about how employees feel about their work environment and how leaders and employees can best work together to create a better place to work.

You are invited to participate in the survey beginning Monday, March 9, 2015. The survey will close Sunday, March 29, 2015. The survey website is available 24 hours a day, seven days a week to accommodate all shifts. Use this Help Sheet as a reference tool when you complete the survey. There is no need to return it. The survey will take less than 10 minutes to complete.

TO COMPLETE YOUR SURVEY, PLEASE FOLLOW THESE TWO EASY STEPS!

- Log on to <https://gx.gallup.com/jhmq12.gx>**
Visit the website, 24 hours a day, seven days a week, between **Monday, March 9, and Sunday, March 29, 2015. Please make sure to enter your unique survey Access Code.** Or, if you have received a paper survey from your manager, fill out and return the paper survey form confidentially.
- You will be asked to provide your survey Access Code, which will be sent to you by email or will be provided to you in a paper survey.

For your review, the statements that you will be asked to rate are listed below and on the back of this page.

	Extremely Dissatisfied				Extremely Satisfied	Don't Know
Q00. On a five-point scale, where 5 means extremely satisfied and 1 means extremely dissatisfied, how satisfied are you with Johns Hopkins as a place to work? You may select any of the numbers 1, 2, 3, 4, or 5 to indicate how satisfied you are. If you don't know, select 0	1	2	3	4	5	0

Please respond to the following statements to describe your present work situation. Please use a five-point scale, where 5 means that you strongly agree with the statement and 1 means that you strongly disagree with the statement. You may choose any of the numbers 1, 2, 3, 4, or 5. Or, you may select "Don't Know/Does Not Apply."

	Strongly Disagree				Strongly Agree	Don't Know/ Does Not Apply
Q01. I know what is expected of me at work.....	1	2	3	4	5	0
Q02. I have the materials and equipment I need to do my work right	1	2	3	4	5	0
Q03. At work, I have the opportunity to do what I do best every day	1	2	3	4	5	0
Q04. In the last seven days, I have received recognition or praise for doing good work	1	2	3	4	5	0
Q05. My supervisor, or someone at work, seems to care about me as a person	1	2	3	4	5	0
Q06. There is someone at work who encourages my development	1	2	3	4	5	0
Q07. At work, my opinions seem to count.....	1	2	3	4	5	0
Q08. The mission or purpose of my organization makes me feel my job is important...	1	2	3	4	5	0
Q09. My fellow employees are committed to doing quality work.....	1	2	3	4	5	0
Q10. I have a best friend at work	1	2	3	4	5	0
Q11. In the last six months, someone at work has talked to me about my progress	1	2	3	4	5	0
Q12. This last year, I have had opportunities at work to learn and grow.....	1	2	3	4	5	0

Appendix C

JHMI Safety Survey with Maslach Burnout Inventory Emotional Exhaustion Items

JHMI Survey 2015

Approved by Lori Paine 2/12/15

Item	Response Scale	Origin	Included on 2013 Survey	Historical Comparison (for work settings that overlap)
My input is well received in this work setting.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
In this work setting, it is difficult to speak up if I perceive a problem with patient care.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
Disagreements in this work setting are resolved appropriately (i.e., not who is right, but what is best for the patient).	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
I have the support I need from others in this work setting to care for patients.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
It is easy for personnel here to ask questions when there is something that they do not understand.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
People in this work setting work together as a well-coordinated team.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Teamwork Domain	YES	NO
I would feel safe being treated here as a patient.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
Medical errors are handled appropriately in this work setting.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
I know the proper channels to direct questions regarding patient safety in this work setting.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
I receive appropriate feedback about my performance.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
In this work setting, it is difficult to discuss errors.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
I am encouraged by others in this work setting to report any patient safety concerns I may have.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES
The culture in this work setting makes it easy to learn from the errors of others.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Safety Climate Domain	YES	YES

People in my work setting understand that when their workload becomes excessive, their performance is impaired.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	Threat Awareness Domain	YES	YES
People in my work setting understand that they are less effective at work when fatigued.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	Threat Awareness Domain	YES	YES
People in my work setting understand that they are more likely to make errors in tense or hostile situations.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	Threat Awareness Domain	YES	YES
People in my work setting understand that fatigue impairs their performance during emergency situations.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	Threat Awareness Domain	YES	YES
Local management (e.g., managers/supervisors) supports my daily efforts.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Local Management	YES	YES
Local management (e.g., managers/supervisors) does not knowingly compromise patient safety.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Local Management	YES	YES
I get adequate, timely info about events that might affect my work from local management (e.g., managers/supervisors).	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Local Management	YES	YES
Senior management (e.g., department leaders, chairpersons, executive leaders) supports my daily efforts.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Senior Management	YES	YES
Senior management (e.g., department leaders, chairpersons, executive leaders) does not knowingly compromise patient safety.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Senior Management	YES	YES
I get adequate, timely info about events that might affect my work from senior management (e.g., department leaders, chairpersons, executive leaders).	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Senior Management	YES	YES
The staffing levels in this work setting are sufficient to handle the number of patients.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	SAQ - Perceptions of Senior Management	YES	YES
Problem personnel are dealt with constructively by our local management (e.g., managers/supervisors)	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Netural, 4 = Agree Slightly, 5 = Agree Strongly, NA	Unscaled	NO	NO

Problem personnel are dealt with constructively by our senior management (e.g. department leadership, chairpersons, executive leaders).	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Unscaled	YES	YES
Safety efforts in my work setting are valuable in protecting patients from harm.	1 = Disagree Strongly, 2 = Disagree Slightly, 3 = Neutral, 4 = Agree Slightly, 5 = Agree Strongly, NA	Unscaled	YES	YES
Hospital units do not coordinate well with each other.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Teamwork Across Hospital Units	YES	YES
Things "fall between the cracks" when transferring patients from one unit to another.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Hospital Handoffs & Transitions	YES	YES
There is good cooperation among hospital units that need to work together.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Teamwork Across Hospital Units	YES	YES
Important patient care information is often lost during shift changes.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Hospital Handoffs & Transitions	YES	YES
It is often unpleasant to work with staff from other hospital units.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Teamwork Across Hospital Units	YES	YES
Problems often occur in the exchange of information across hospital units.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Hospital Handoffs & Transitions	YES	YES
Hospital units work well together to provide the best care for patients.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Teamwork Across Hospital Units	YES	YES
Shift changes are problematic for patients in this hospital.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, NA	HSOPS - Hospital Handoffs & Transitions	YES	YES
We have a good "map" of each other's talents and skills.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
We talk about mistakes and ways to learn from them.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
We discuss our unique skills with each other so we know who on the unit has relevant specialized skills and knowledge.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
We discuss alternatives as to how to go about our normal work activities.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO

When giving report to an oncoming team member or team, we usually discuss what to look out for.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
When attempting to resolve a problem we take advantage of the unique skills of our colleagues.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
We spend time identifying activities we do not want to go wrong.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
When errors happen, we discuss how we could have prevented them.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
When a patient crisis occurs, we rapidly pool our collective expertise to attempt to resolve it.	1 = Not at all, 2 = To a very limited extent, 3 = To a limited extent, 4 = To a moderate extent, 5 = To a considerable extent, 6 = To a great extent, 7 = To a very great extent	Safety Organizing Scale*	NO	NO
I feel emotionally drained from my work	1 = Never, 2 = A few times a year or less, 3 = Once a month or less, 4 = A few times a month, 5 = Once a week, 6 = A few times a week, 7 = Every day	MBI - Exhaustion/Resilience*	NO	NO
I feel used up at the end of the workday.	2 = Never, 2 = A few times a year or less, 3 = Once a month or less, 4 = A few times a month, 5 = Once a week, 6 = A few times a week, 7 = Every day	MBI - Exhaustion/Resilience*	NO	NO
I feel tired when I get up in the morning and have to face an	3 = Never, 2 = A few times a year or less, 3 = Once a month or less, 4 = A few times a month, 5 = Once a week, 6 = A few times a week, 7 = Every day	MBI - Exhaustion/Resilience*	NO	NO
Working all day is really a strain for me.	4 = Never, 2 = A few times a year or less, 3 = Once a month or less, 4 = A few times a month, 5 = Once a week, 6 = A few times a week, 7 = Every day	MBI - Exhaustion/Resilience*	NO	NO
I feel burned out from my work.	5 = Never, 2 = A few times a year or less, 3 = Once a month or less, 4 = A few times a month, 5 = Once a week, 6 = A few times a week, 7 = Every day	MBI - Exhaustion/Resilience*	NO	NO

In what way will the next patient in your work setting be harmed? How could this harm be prevented?

Standard Demographic Questions To Be Added

*Data for these items will be provided in an Excel file and not included in any reports or on the HealthBench Dashboard.

Appendix D

CUSP Scorecard

General Instructions

1	CUSP Facilitator should complete with assistance of unit-based CUSP Champion and or CUSP team.
1	Along the top row, replace "Unit Name" with the name of each CUSP team.
2	Fill-in the appropriate value for each measure for each CUSP team.
3	Put in only one value for each measure. Do NOT include a range of numbers.
4	Send questions to Melinda Sawyer: msawyer1@jhmi.edu

Instructions for Measures

1	Numerator = number of CUSP team meetings cancelled in last 6 months. Denominator = number of CUSP meetings scheduled in last 6 months. Total = (numerator/denominator) x 100
2	Numerator = number of executive absences of CUSP meetings that occurred. Denominator = Number of CUSP team meetings that occurred. If the CUSP meeting was cancelled this does not count toward an executive absence. Total = (numerator/denominator) x 100
3	Numerator = number of provider champion/designee absences of CUSP meetings that occurred. Denominator = Number of CUSP team meetings that occurred. If the CUSP meeting was cancelled this does not count toward an provider champion/designee absence. Total = (numerator/denominator) x 100
4	Numerator = number of current, permanent staff that has received Science of Safety training in last 2 years. Denominator = number of current, permanent staff on the unit. Total = (numerator/denominator) x 100
5	Only include attendance for the primary unit-based CUSP champion. Give 1 if unit champion has attended 1 of these training programs and 2 if he/she has attended both.
6	If the unit-based champion gets time per schedule, calculate what this would average to per week. Ex. 8 hours per 6 weeks = $8/6 = 1.33$ hours per week
7	Only include defects when a system has been changed or new process developed. Do not include re-education of staff or discussion of a defect with staff in this measure.
8	Improvement plans must include the following to be counted: data is being collected AND there is an improvement plan being currently implemented AND there is a specific goal stated. If any of these 3 are missing do not count.
9	This score is taken from the area's most recent culture survey
10	This rate is taken from the area's most recent culture survey

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CURRICULUM VITAE

Part I

PERSONAL DATA

Sarah E. Mossburg MS, BSN, ACRN

Home: 123 W. George Mason Road
Falls Church, VA 22046
703.582.6856 (cell)
Born: May 15, 1976
Beaver Falls, Pennsylvania

EDUCATION

Year	Degree	Institution/Location
2018*	PhD	Johns Hopkins University, Baltimore, MD
2003	MS	Georgetown University, Washington, DC
1998	BSN	University of Pennsylvania, Philadelphia, PA

*planned graduation

CURRENT LICENSE AND CERTIFICATION

Year	Source	Type
2007	Association of Nurses in AIDS Care	ACRN (AIDS Certified)
1998	Virginia Board of Nursing	RN

PROFESSIONAL EXPERIENCE

Years	Position	Institution	Location
2018	Researcher	American Institutes for Research	Washington, DC
2015-2017	Informatics Analyst	Inova	Falls Church, VA

2015-2015	Nurse Educator	Inova	Falls Church, VA
2012-2015	Staff Nurse	Virginia Hospital Center	Arlington, VA
2011-2014	Adjunct Faculty	George Washington University	Ashburn, VA
2011-2011	Adjunct Faculty	Marymount University	Arlington, VA
2009-2011	Clinical Specialist	Inova Mount Vernon Hospital	Alexandria, VA
2006-2007	Director of Professional Practice	Inova Mount Vernon Hospital	Alexandria, VA
2006-2007	Master Preceptor/ Educator	Inova Mount Vernon Hospital	Alexandria, VA
2005	Clinical Instructor	VCU	Richmond, VA
2004-2006	Nurse Manager	VCU Medical Center	Richmond, VA
2001-2003	Clinical Research Coordinator	Georgetown University Medical Center	Washington, DC
1998-2003	Clinical Nurse	Washington Hospital Center	Washington, DC

HONORS AND AWARDS

2016-2018	Jonas Nurse Leader Scholar, Jonas Center for Nursing and Veterans Healthcare
2015-2018	Johns Hopkins University School of Nursing Graduate Assistantship
2012	Sigma Theta Tau International Inductee, Sigma Theta Tau International
2009	IMVH Leader of the Month, Inova Mount Vernon Hospital
2008	Regional Finalist: Excellence in Mentoring, Nursing Spectrum Awards

2003 Upsilon Phi Delta Society Inductee, Upsilon Phi Delta Society

1994 Ursinus College Scholarship

RESEARCH

Research Coordinator (2017): African Immigrant Health Survey (PI: Yvonne Commodore-Mensah, PhD)

Study team member (2017): Systematic Review of African Healthcare Worker's Exposure to Occupational Health Hazards (PI: Yvonne Commodore-Mensah, PhD)

Study team member (2016-2017): A Mixed Methods Evaluation of Safety Culture and Work Practices Among Inpatient Hospital Units (PI: Sallie Weaver, PhD)

Principal Investigator (2010): Assessing Interruptions During the Medication Retrieval Process

Co-Investigator (2009): Factors that Influence Nursing Decisions about Calling a Rapid Response Team (PI: Jacqueline Wavelet)

SCHOLARSHIP

Publications

Peer-reviewed (* indicates data-based)

1. ***Mossburg, SE**, & Dennison Himmelfarb, C. (in press) The Association between Professional Burnout and Engagement with Patient Safety Culture and Outcomes: a Systematic Review. *The Journal of Patient Safety*.
2. ***Mossburg SE**, Weaver SJ, Pillari MS, & Daugherty Biddison ET. (in press) Differences in Manifestations of High Reliability Principles on Hospital Units with High- and Low-Performing Safety Profiles: a Qualitative Analysis. *Journal of Nursing Care Quality*.
3. **Mossburg, SE**. (2018). Baby Boomer Retirement: Are you up to the Challenge? *Nursing Management*, 49(3), 13-14. doi:10.1097/01.NUMA.0000530428.53528.f2
4. ***Weaver SJ, Mossburg SE**, Pillari MS, Kent P, & Daugherty Biddison EL. (2017) Examining variation in mental models of influence and leadership among nursing leaders and direct care nurses. *Journal of Nursing Care Quality*. Advanced online publication. doi:10.1097/NCQ.0000000000000298

5. **Mossburg, S**, Wavelet, J, & Hughes, B. (2008). Advancing Knowledge, Skills and Perceptions of Competence in New Graduate Nurse in the Critical Care Setting. *Critical Care Nurse*, 28(2), e2. (Conference Abstract)

Conference Meetings/Presentations

International

Mossburg, SE, Dennison Himmelfarb, C. (2018, June) *Making Care Safer: Exploring Predictors and Impact of RN Burnout and Engagement*. Podium presentation at the biennial Sigma Theta Tau International European conference, Cambridge, U.K.

Mossburg, SE, Daugherty Biddison, E, & Weaver, S. (2018, June) *Manifestations of High Reliability Principles in Healthcare*. Podium presentation at the biennial Sigma Theta Tau International European conference, Cambridge, U.K.

Mealy, MA, Yeshokumar, AK, **Mossburg, SE**, & Levy, M. (2016, April) *Long-Term Disability in Neuromyelitis Optica Spectrum Disorder is Associated with Delay in Diagnosis, MRI Lesion Length & Location and Race*. Poster session presented at the annual American Association of Neurology conference, Vancouver, BC.

National

Mealy MA, **Mossburg SE**, Levy M (2018, April) *Contributors to Long-Term Disability in Patients with Neuromyelitis Optica Spectrum Disorder*. Poster session presented at the annual American Academy of Neurology Annual Meeting, Los Angeles, CA.

Mossburg, S., & Dennison-Himmelfarb, C. (2017, October) *Professional Burnout and Engagement are Associated with Patient Safety Culture and Safety Outcomes: a State of the Science Review*. Poster presentation at the annual Nursing Management Congress conference, Las Vegas, NV.

Mossburg, S. (2011, March) *Our Own Worst Enemy: Interruptions During Medication Retrieval*. Podium presentation at the annual conference of the National Association of Clinical Nurse Specialists, Baltimore, MD.

Wavelet, J, & **Mossburg, S.** (2011, January) *The Tipping Point: Factors that Influence Nursing Decisions about Calling a Rapid Response Team*. Poster presentation at the annual National Database of Nursing Quality Indicators Conference, Miami, FL.

Wavelet, J, & **Mossburg, S.** (2010, May) *The Tipping Point: Factors that Influence Nursing Decisions about Calling a Rapid Response Team.* Poster presentation at the annual conference of the American Association of Critical Care Nurses, Washington, DC.

Mossburg, S, Wavelet, J, & Hughes, B. (2008, May) *Creating Success: Advancing Knowledge, Skills and Perceptions of Competence in New Graduate Nurse in the Critical Care Setting.* Poster presentation at the annual conference of the American Association of Critical Care Nurses, Chicago, IL.

Mossburg, S. (2005, April) *Soaring to Excellence: An Innovative Nursing Care Model in the New Women's Surgical Care Wing.* Poster presentation at the annual conference of the American Organization for Nurse Executives, Chicago, IL.

Local

Mossburg, S. (2007, October) *Elements of a Research Proposal.* Podium presentation at the Inova Health System fourth annual Fall into Research conference, Fairfax, VA.

EDITORIAL ACTIVITIES

Peer Review Activities

2017	Advances in Nursing Doctoral Education and Research
2017	<u>New Horizons in Patient Safety: Safe Communication</u>

PROFESSIONAL ACTIVITIES

Society/Association Membership

American Society of Professionals in Patient Safety
2017 Member

Sigma Theta Tau, Nu Beta Chapter
2018 Member
2017 Member

American Association of Critical Care Nurses
2016 Research Abstract Review Panel Member, National Teaching Institute
2011 Research Abstract Review Panel Member, National Teaching Institute
2010 Research Abstract Review Panel Member, National Teaching Institute
2009 Research Abstract Review Panel Member, National Teaching Institute
2008 Research Abstract Review Panel Member, National Teaching Institute
2008 Member

Sigma Theta Tau, Epsilon Beta Chapter
2015 Research Grant Review Committee
2012 Research Grant Review Committee
2012 Member

Consultations

2008-2015 American Nurses Credentialing Center, Pathway to Excellence, Reviewer

Part II

EDUCATIONAL ACTIVITIES

Summer 2017	Nurs 110.503 Application of Research to Practice, Teaching Assistant, 61 students, MSN program
Fall 2014	Nurs 3115 Clinical Skills Lab: Adult Medical-Surgical 2, Clinical Instructor, 6 students
Spring 2014	Nurs 3115 Clinical Skills Lab: Adult Medical-Surgical 2, Clinical Instructor, 6 students
Fall 2013	Nurs 6180 Dimensions of Professional Nursing, Course Coordinator, 2 students, MSN program
Fall 2013	Nurs 3115 Clinical Skills Lab: Adult Medical-Surgical 2, Clinical Instructor, 8 students
Spring 2013	Nurs 3115 Clinical Skills Lab: Adult Medical-Surgical 2, Clinical Instructor, 7 students
Fall 2012	Nurs 3113 Clinical Skills Lab: Adult Medical-Surgical 1, Clinical Instructor, 9 students
Summer 2012	Nurs 4117 Community and Public Health, Clinical Instructor, 18 Students (3 clinical groups)
Spring 2012	Nurs 3113 Clinical Skills Lab: Adult Medical Surgical 1, Clinical Instructor, 15 students (2 clinical groups)
Fall 2011	Nurs 3113 Clinical Skills Lab: Adult Medical Surgical I, Clinical Instructor, 18 students (2 clinical groups)
Fall 2011	NU 332 Illness Management in Adults, Clinical Instructor, 16 students (2 clinical groups)
Fall 2005	Nurs 325 Nursing of Adults I, Clinical Instructor, 7 students